THE

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THE

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## THE POSTPONEMENT OF THE CORONATION.

THE deplorable events which took place too early for extended notice in our issue of last week, have stirred the feelings of the British nation to their very depths. Like the news concerning the health of Her Late Majesty Queen Victoria, the announcement made on June 24th to the effect that King Edward VII. was undergoing a serious operation, fell like a thunderbolt upon all classes of the community; a bolt, moreover, the effect of which was accentuated by the fact that when it fell all were looking forward to, if not actually enjoying, the Coronation festivities. In spite of the grievous loss and disappointment which the postponement has occasioned, it is not too much to say that the feeling uppermost in the minds of all has been one of profound sympathy with His Majesty in his affliction. Thoughts of private loss and inconvenience gave way to feelings which were shared by the entire nation. Happily, as we write this, His Majesty is rapidly recovering, a circumstance which lifts a great weight off the minds of His loyal subjects. It is impossible, however, to overlook the far-reaching effect of the postponement of a Coronation pageant; more especially a pageant which follows immediately upon a declaration of peace, and with regard to which there has been no stint in expenditure, either of public or private money.

Many serious questions must arise, and one of those to which it is our duty to refer, is the responsibility of those who have supplied, or who were to supply, electric fittings, lamps and energy. With regard to fittings and lamps, it is possible that for the purposes of the larger illuminations these had all been supplied and placed *in situ* before the disappointing news was published to the world. It is also possible that, in many cases, the hire or purchase money had been handed over, and in others the signs are to remain in position for the present, in waiting for public rejoicings at the King's recovery. But what of all the complications which must have arisen? Thus, suppose the proprietor of a house upon the route had ordered an illuminated sign to be prepared, for use on the two eventful nights outside his premises. Before delivery, but after the work has been completed, it is announced to the world that there are to be no processions. What are the rights of the parties? Upon whom is the loss to fall? Doubtless the prudent man will have insured against the risk, or will have made the fulfilment of his part of the contract conditional. But how can it be said in a case where no such precautions have been taken, that payment for the loan or sale of such articles was conditional upon there being actual need for them? So difficult is it to define the legal position of the parties in such a case, that we trust all concerned may find it possible to come to an amicable arrangement.

Litigation is distressing at any time; but it becomes especially distasteful when the innocent and illustrious cause of it is manfully struggling with a painful disease, the

progress of which is watched with the greatest anxiety by every British subject. Seeing that those who were under contract to supply fittings of all kinds had actually supplied, or were in a position to supply, the greater part of them before the storm broke, it may be that they will not suffer any particular loss.

**The Lords and the Embankment Tramway.**

The House of Lords has done its worst with the L.C.C. Embankment conduit tramway proposal. By cutting out all powers to construct tramways south of the Strand, it has thrown out what was a quite harmless scheme from the general traffic point of view, and one that in a few years might have formed an invaluable connection between the street tramway systems of North and South London. It is all very well for Lords, who by demonstration are now clearly out of touch with the needs of the general public in regard to travelling facilities, to talk of the project as an "unnecessary piece of extravagance," a "useless" scheme, and one which if passed would commit their lordships to "a gigantic extension of that system." Their lordships, or some of them, have apparently yet to learn that it is a "gigantic extension" of tramway facilities that has for years been one of the crying needs of this great city of London. We agree that the London County Council should be occasionally taught that it is not to have things all its own way; but having got possession of so many miles of the tramways, and being pledged to so many miles more, it is a little ridiculous to hamper much-needed development now that it is in the mind of the Council to make it. Perhaps by next year the Lords will have given a little further consideration to the proposal, and will look at it with a view to conferring the greatest good upon the greatest number.

**Trolley Traction.**

It is very satisfactory to find that the trolley system, which has been so often and so roundly abused, is now having its real worth recognised. Mr. Gerald Balfour, speaking at the Agricultural Hall on Monday, emphasised the fact that it was the trolley system which had made the development of electric traction possible in this country, and it is partly because of our municipal councillors and some others failing then to appreciate the real position of matters that we are as far as we are to-day behind our Continental and American rivals. We commend to our readers' attention the brief and timely address which was delivered by Mr. J. H. Rider to the opening meeting of the annual convention of the Municipal Electrical Association in London on Wednesday. The special study which that gentleman has made of the different traction systems of the world eminently qualifies him to express an authoritative view of the relative merits of the trolley and conduit methods, and the conditions which justify the employment of the latter. Mr. Rider, in his address, which appears on another page, said what his councillors might have known six or seven years ago if they would only have believed it—namely, that if there is anything disagreeable to the eye in overhead trolley construction, it is the fault of the designer and not of the system, as it is by no means a difficult matter to design and erect an overhead line which shall look well in almost any locality. Mr. Rider, notwithstanding his official position, is by no means enamoured of slots, and the well-considered advice which he gave to municipal councillors and engineers on Wednesday should go far to remove any tendency that may exist among them at the moment for experimenting with untried or extravagant systems. He does not look with equanimity upon the prospects for combined trolley and conduit working on the lines now being pursued at Bournemouth. The position of electric traction in London is certainly becoming interesting in view of Mr. Rider's attitude.

**The Effect of Accumulators on Generator Design.**

We have heard it said that somebody "got the sack" on an occasion when a generator ran its six or eight-hour full-load test and remained stone cold, but we never heard of anyone being discharged for the opposite fault. A traction generator ought not to be required to run its rated capacity load for six hours. English machines will do it; but English machines are rated much too low, and will do work that an American machine cannot touch. Yet tenders for, say, 100-KW. sets are all examined as to price, without reference to the real size of the machine. Let us suppose a case. A machine is ordered of 100 KW. capacity. Its performance is satisfactory, because it is never called upon for an average output rate of more than 25 or 30 KW. Then some other engineer, who has installed a battery also, orders the same machine, and sets it steadily grinding out energy at the 100 KW. rate. In place of 25 or 30 per cent. the load factor is now probably 90 per cent., and the machine will not last long at that rate if it is designed on the lines that have been hitherto adopted—lines that were fixed by the conditions prior to the accumulator. English machines, however, which have been extravagantly designed for traction duty will now be found equal to their ratings, and will run the steady full load possible with accumulators.

The increase in accumulator installations will surely bring this question to the front in the experience of traction men, and those who have not already run against it should be on their guard against being found with insufficient machines. It has often been urged, for example, that by means of accumulators the cost of generating plant will be greatly reduced. Where a generator of 100 KW. has been required to deal with a station load factor of 25 per cent., it is natural to suppose that a 30-KW. set will serve when a battery is used; but this is true only for the machines of those makers who have honestly made their machines capable of long hours of running at rated loads, and it is not true of the economical designs of America and Germany. We are not finding fault with those designs so much as with those engineers who do not distinguish between a liberally and an economically designed machine. A machine perhaps runs hot at its trial, and the engineer realises that such a temperature will never be reached on daily load. He wants the machine, and takes it over, and has no reason to complain of it; but he forgets that he perhaps gave the order for that machine at a small reduction in price below that of an English machine that would have run the trial load and not have attained half the rise of temperature. The system is unfair to the liberally designed article. The economical machine struggles through its test, and is accepted as the lesser of two evils because delay is undesirable.

It is to the smaller stations that these remarks more particularly apply; larger systems with their better load factors are less affected. Each case must, of course, stand by itself. Some engineers, we know, are fully alive to the point raised, but the general success of the economically designed machine points to the fact that the true bearing of the circumstances of traction has been overlooked, to the detriment of English manufacturers, who have perhaps allowed lighting practice to overweigh their designs too much. The rating of lighting and traction machines alike ought to be based on a capacity to turn out so many units at a steady load, and engineers should know how to order machines, and should not be hoodwinked by makers' ratings. A bonus or penalty clause might perhaps

effect something in the way of securing more liberal proportions. A penalty for too high a temperature could be enforced where a rejection has hitherto been too inconvenient.

Our Fiftieth Volume.

PERHAPS we may be pardoned for drawing attention to the fact that with our last issue we completed the fiftieth volume of the ELECTRICAL REVIEW. The index therefor will be found in the present number. Those who are the fortunate possessors of the whole set dating from November 15th, 1872, have a complete history of electrical engineering science and industry practically from the commencement. Some of those early volumes furnish very interesting reading in the light of subsequent developments.

Coronation Science Honours.

WE offer our congratulations to the several eminent men of science on the well-merited honours which His Majesty the King has been pleased to confer upon them. The institution of a new Order of Merit has given complete satisfaction; and Lord Rayleigh, F.R.S., and Lord Kelvin, G.C.V.O., F.R.S., are the first distinguished scientists to receive the appointment. Lord Kelvin will also be sworn of His Majesty's Most Honourable Privy Council. The honour of knighthood has been well earned by Dr. Oliver Lodge, Mr. W. Mather, M.P., Mr. John Thorneycroft, F.R.S., and Prof. Arthur Rucker. Mr. G. W. Smyth, assistant secretary to the G.P.O., becomes a C.B.

**The German Nernst Lamp.**—We have received from the Allgemeine Elektricitäts Gesellschaft, Berlin, the results of tests made by the Reichsanstalt with their model of the Nernst lamp. The lamps tested were of model B, one with a straight luminous filament, and the other with a bent luminous filament. The following tables give the figures obtained for the two kinds of lamps:—

I.—LAMPS WITH STRAIGHT LUMINOUS FILAMENT. Mean of five lamps. Tension 220 volts.

| Duration of test. | Current. | Candle-power. | Decrease in C.P. | Energy consumed per candle. |
|---|---|---|---|---|
| 0 hours | 0·264 amp. | 35·1 candle | 0 % | 1·65 watt per candle |
| 50 „ | 0·261 „ | 32·4 „ | 7·7 % | 1·77 „ „ |
| 100 „ | 0·260 „ | 32·3 „ | 8·0 % | 1·77 „ „ |
| 200 „ | 0·253 „ | 30·1 „ | 14·0 % | 1·85 „ „ |
| 300 „ | 0·242 „ | 27·5 „ | 21·6 % | 1·93 „ „ |
| 400 „ | 0·237 „ | 26·5 „ | 24·5 % | 1·97 „ „ |
| Mean during 400 hours. | 0·251 amp. | 30·1 candle | — | 1·83 watt per candle |

Of the five lamps, the filament of one burnt out after 310 hours, of another after 379 hours, the three remaining filaments being intact at the end of 400 hours. The mean longevity of a filament thus exceeded 378 hours. The heating spirals were uninjured.

II.—LAMPS WITH BENT LUMINOUS FILAMENTS. Mean of five lamps. Tension 220 volts.

| Duration of test. | Current. | Candle-power. | Decrease of C.P. | Energy consumed per candle. |
|---|---|---|---|---|
| 0 hours. | 0·259 amp. | 40·1 candle | 0 % | 1·42 watt per candle |
| 50 „ | 0·259 „ | 36·3 „ | 9·5 % | 1·57 „ „ |
| 100 „ | 0·259 „ | 38·1 „ | 5·0 % | 1·49 „ „ |
| 200 „ | 0·247 „ | 34·1 „ | 15·0 % | 1·59 „ „ |
| 300 „ | 0·238 „ | 33·2 „ | 17·2 % | 1·58 „ „ |
| 400 „ | 0·219 „ | 27·6 „ | 31·0 % | 1·75 „ „ |
| Mean during 400 hours. | 0·245 amp. | 34·4 candle | — | 1·57 watt per candle |

Of the five lamps, one of the filaments gave way after 150 hours, the other four were intact after 400 hours. The mean longevity, therefore, exceeded 350 hours. The heating spirals of two lamps gave way after 110 hours, and 395 hours. The mean longevity of the lamps, having regard to the heating spirals, is therefore 291 hours. The lamps, of which the measurements are given in Table I., are at present in the market. Those lamps to which Table II. refers, are in preparation, but the A.E.G. are not yet able to specify a date at which they will be able to supply them. The present demand for Nernst lamps has already necessitated large additions to their factory.

## WIRELESS TELEGRAPHY AND SUBMARINE CABLES.

BY EMILE GUARINI.

(*Concluded from Vol.* 50, *page* 1051.)

To obtain multi-communication — duplex, for instance— in opposite directions simultaneously is, fortunately, more simple than in wireless telegraphy. In fact, in wireless telegraphy, where we have radiation to take into account, we require a large source of energy because we allow the waves to be propagated in every direction instead of concentrating them upon a given point; whereas, in the case under consideration—that of conduction—a small source of energy is sufficient. If in wireless telegraphy we did not take special precautions to separate the receivers from the transmitters or to protect them by screens, sheaths, &c., simultaneous transmission and reception would be impossible, as the coherer would be influenced by the transmitter of the same station and perhaps rendered useless.

In the case under consideration (fig. 6) it is sufficient (1) that at each station the receivers should differ greatly in period from the transmitters; (2) that metal boxes and self-

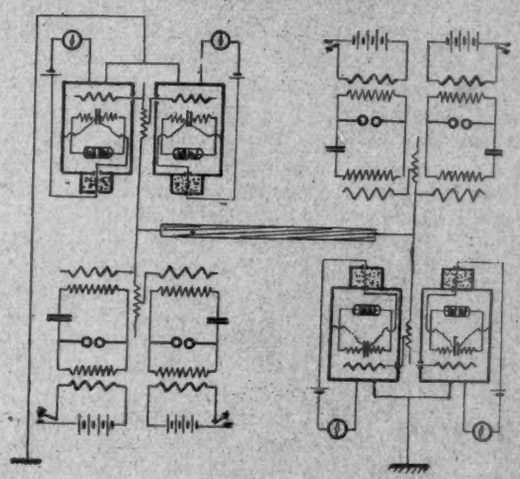

FIG. 6.

induction coils placed in boxes of block tin should protect the receivers from the direct action of the transmitters. Fig. 6 shows the duplex arrangement, but we have only to increase the number of transmitting and receiving couples to obtain a greater number of simultaneous communications.

It would show very little knowledge of human nature to hope—*i.e.*, if we assume as accomplished what we have been briefly suggesting—that the cable companies will decide to give up, either at once or in the near future, all their old material. It is, therefore, interesting to see whether, while continuing to employ the existing material for communicating with the ordinary current either by the single or the duplex system, they can increase the efficiency of the cables by supplementary transmissions by means of Hertzian waves. The first solution of the problem that suggests itself to the mind is exceedingly simple, or it seems so, at least, to us: the core of the cable serves for the transmission of the ordinary current, and the sheathing—which is also insulated*—for the transmission of Hertzian waves at low tension. Moreover, the core of the cable can be used for the simultaneous transmission of the two kinds of current, as M. Turpain showed in his experiments on multi-communication in ordinary telegraphy. All that is required is transformation at the transmitter and the receiver as we have suggested. Generally speaking, any system of submarine telegraphy is capable of being used for supplementary simultaneous communications by Hertzian waves. In all cases we have only to fulfil the following conditions:—(1) The charging and discharging currents must not influence the apparatus with coherer; (2) the Hertzian waves must not be conveyed to earth through the ordinary telegraph apparatus.

* M. Guarini appears to be unfamiliar with the construction of a submarine cable.—EDS. ELEC. REV.

We can fulfil the first condition (1) by using for Hertzian waves, as we have done, open circuits (without earth); a current passing through an open circuit depending on the product of frequency × capacity, low frequency currents would have little effect on circuits of comparatively small capacity; (2) by syntonising the coherer apparatus, so that it does not answer to great lengths of wave in the charging

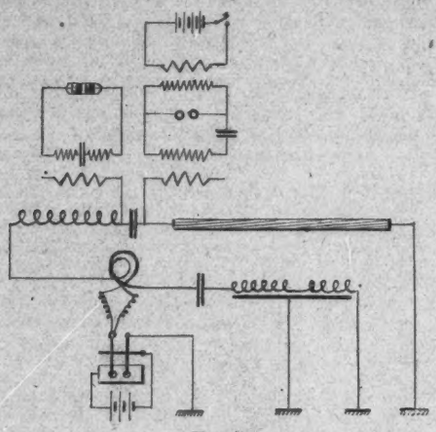

Fig. 7.

and discharging currents of the cable. The second condition is fulfilled by using self-induction coils in the circuit through the ordinary apparatus to earth, which, by their impedance, prevent the high frequency waves from passing to earth.

Thus, let us take the case of differential duplex communication. The resulting arrangement is shown in fig. 7. The transmitter (with secondary of thick wire) is connected with the cable, and the receiver with a self-induction coil, and with the condenser that divides the cable.

We have only, at the time of writing this article, sketched out the problem; the difficulties that will arise in practice are as numerous as they are great. They are great, but it does not seem to us that they are insurmountable. But even assuming that practical experience will crown all these suggested arrangements with success, we do not honestly think that the fate, the inevitable fate, of the cable will be altered. The death sentence of the cable was read by Marconi on December 12th, 1901, at the time of his trans-Atlantic experiment. The carrying out of this sentence is now only a question of time. It will depend both on the cable companies, and on the pioneers of wireless telegraphy.

Increased efficiency in the existing cables, and all possible and imaginable improvements in submarine telegraphic apparatus will merely be good medicines, *i.e.*, more or less efficacious palliatives, whereas what the case requires is surgery. The defects of the cable are in the core, *i.e.*, in the cable itself, and they will remain as long as the cable remains.

## THE ELECTRIC TRAMWAYS EXHIBITION.

On Monday last the Right Hon. Mr. Gerald W. Balfour, M.P., as President of the Board of Trade, performed a dual function of electric traction interest at the Agricultural Hall, Islington. At 12 o'clock he opened the twelfth International Tramways and Light Railways Congress of the Union Internationale Permanente de Tramways in the Berners Hall, cordially welcoming the many foreign delegates who have come over to discuss tramway matters together with us, and to see what is happening over here in tramway and railway construction, working and management. He expressed the great pride that he took in performing this duty on behalf of His Majesty's Government.

This interesting function concluded, the company proceeded to the Hall, where Mr. Balfour formally opened the Exhibition, and the inaugural luncheon was afterwards served in the North Gallery. Altogether between 400 and 500 sat down, this large company including representatives of every branch of the now rapidly spreading electric tramways industries of this country and the Continent. There were engineers and managers who are engaged upon our London and Provincial municipal and private tramway systems, many distinguished tramways officials from Continental cities, electrical manufacturers from all departments, and the Light Railways Commission, the Board of Trade, the L.C.C. and the Institution of Electrical Engineers, were among the public bodies represented. The exhibition was promoted by the *Tramway and Railway World* Publishing Company, and Mr. James W. Courtenay, chairman of the Exhibition Committee, and member of the Council of the Tramways and Light Railways Association, presided at the luncheon, Mr. Gerald Balfour being on his right.

The toast "The King," proposed by the chairman, was most enthusiastically received, as was also that of "The Queen, Prince and Princess of Wales, and other members of the Royal Family."

Mr. Gerald Balfour, M.P., then proposed the "Union Internationale Permanente de Tramways." He said that that toast would be received with all honour. It would be difficult to find a note more characteristic of the present age than the existence of so many international unions and associations for the promotion of useful objects. Look back 50 years. How many international unions and associations were there then? If they looked back a century he doubted if they would find a single one. Was he too sanguine if he ventured to express the belief that this was a sign that what was known as the brotherhood of nations was not entirely a dream? Turning to the particular industry represented by their own international union, he was afraid that we in this country must allow that we had probably more to learn from distinguished friends who had come from the other side of the Channel than they had to learn from us. At all events, that was what he was assured by a deputation which he received not long ago from the electrical engineers of this country, who deplored the backward state of electric traction in the United Kingdom, and attributed it, he was sorry to say, chiefly to the legislative restrictions which, he was afraid, were traced to his department, and from which other countries were free. He saw he had struck a responsive note. But he ventured to doubt if the explanation was sufficient to account for the fact, although he was ready to admit its accuracy. He hoped that this inferiority, of which he was painfully conscious, was not going to last for ever. In this country we had been taking a nap, but he thought he saw some signs of an awakening. The first electrically equipped tramway in the country belonged to the Giant's Causeway Tramway Company in Ireland. It was a very primitive affair, and the electric current was conducted along a low rail, which the public were warned not to sit upon. That line was continued until two years ago, notwithstanding that it gave rise to numerous accidents, though, happily, mostly to animals. It was, perhaps, some testimony to the leniency with which the Board of Trade imposed these regulations, of the stringency of which so much had been made, that it allowed the company to continue running such a line until 1900, when this primitive system was replaced by an overhead trolley system. It was with the introduction of the latter system that the supremacy of electric traction was established. This system was not so quickly appreciated in the United Kingdom as by our neighbours. The consequence was that we had undoubtedly got a little behind. But we meant to make up for lost time and to make good the distance by which we had fallen behind. The advantages of cheap and rapid transit were coming to be more and more appreciated in this country, while in electric traction was to be found the most satisfactory solution of the problem concerning the housing of the working classes.

The toast was very courteously acknowledged by M. Leon Janssen, general secretary and director of the Brussels Tramways.

Mr. James Swinburne, president of the Institution of Electrical Engineers, then proposed "The Tramways Industry," or, as he put it, "Our Noble Selves." He said that the question of the development of locomotion inside and outside towns was now becoming a matter of national importance. The principal question was how to get people out of the crowded towns and into the country. In the course of other remarks Mr. Swinburne said that tramway

authorities did not seem to be fully aware of the existence of gas and water pipes.

Mr. D. Boyle, the chairman of the Manchester Tramways Committee, responded at some length, giving statistics to show the progress of tramways in this country during the past 30 years. Manchester now had a section of 50 miles of tramways running out of a total of about 150 miles, and its first object was *not* the creation of profits which would be placed to the reduction of the city rates.

The gathering then broke up.

On Tuesday morning the Exhibition was opened to the public, and will continue open until Saturday next week, July 12th. We commence in the following columns a general account of the exhibits. There are several features which call for special mention. The British Westinghouse Company has a gas-driven plant, furnishing energy for working a 310-ft. length of overhead trolley line, whose chief object is to demonstrate the advantages of the firm's magnetic brake. Messrs. Dick, Kerr & Co. exhibit among many other things at their joint Preston stand a specimen of the cars they are supplying to the L.C.C. for their South London conduit lines; also their fireproof motors for the Liverpool Overhead Railway, to which we refer on another page of this issue. The European McGuire Company, whose works are now in full swing at Bury have an interesting show of snow sweepers and ploughs. The Brush Electrical Engineering Company's exhibit stands out prominently. That of the B.T.H. Co. possesses great interest by reason of the fact that there is to be seen in operation a complete exhibit of the company's master control system, which is to do service on the trains of the G.N. and City Railway, which, by the way, will now very soon be ready for opening. There are, of course, many other exhibits calling for mention, including those of such well-known manufacturers as Blackwell's, Ferranti, Johnson & Phillips, Bruce Peebles, Meldrum's, Askham Bros. & Wilson, Hadfield's, British Griffin, and so on, but space forbids our detailing these this week. They cover pretty well everything of current interest in connection with electric tramway and railway work, and any electrical engineer who makes his way to the Agricultural Hall before the end of next week will find many things worthy of his study and attention.

As to the congress of the Tramways Union, which commenced its sittings also on Tuesday morning, we must content ourselves this week with a mention of the subjects which were set down for consideration. The communications consisted in the main of reports compiled from statistical information furnished by the engineers or managers of the different companies on the Continent connected with the Union :—

"Transfer Tickets (*Correspondances*)."—M. Lavalard, manager, Paris Omnibus Company.

"Narrow *v.* Ordinary Gauge."—M. C. de Burlet, general director, Belgian Light Railway Company.

"Brakes."—M. Poetz, engineer-in-chief of the Hamburg Tramways Company.

"Proposed Basis for Estimating Power of Motors."—Dr. G. Rasch, of the Polytechnic School, Aix-la-Chapelle.

"Conditions under which Tramways may be laid on Roads."—M. Albert Janssen, general secretary and director of the Brussels Tramways.

"Laws regarding Tramways and Light Railways."—Mr. R. H. Scotter.

"Car Sheds."—M. Trautweiler, engineer-in-chief, Strasburg Tramways Company.

"Traction Systems."—M. Ziffer, director of several Austrian light railway companies.

"Profitable Employment of Rolling Stock."—M. J. H. Neissen, manager of the Amsterdam Corporation Tramways.

"Central Stations."—M. Ch. Thonet, director of the General Contract Company of Liège.

"Cost of Electric Energy."—M. Ch. Thonet.

To-day's subjects are :—

"Underground (Tube) Railways."—Mr. P. V. McMahon, chief engineer of the City and South London Railway.

"Carriage of Luggage—Goods and Mails."—Mr. C. Marsal, manager of the Biella Light Railways.

"Heating of Cars."—M. Peiser, chief engineer, Great Berlin Tramways Company.

Report by Messrs. Leon Janssen (managing director of the Brussels Tramways) and Geron (director of the Cologne Tramways Company) on a "Uniform System of Accounts."

Various Communications.

Closing of the Congress.

Various visits to electric light and traction stations and systems in London were also arranged for our foreign visitors.

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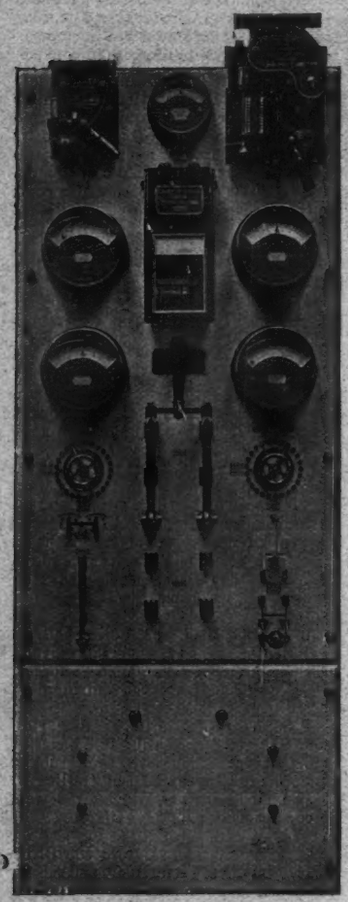
## THE EXHIBITS.

**The Johnson-Lundell Electric Traction Co., Ltd.**, of 16a, Soho Square, London, W., exhibit a dynamo in which they claim that there has been achieved for the first time a scientific and commercial correction of the tendency of armature currents to distort the magnetic field; this correction being effected without the employment of special windings or other supplemental devices permits of the actual reduction of size, weight and cost of a machine for any given output. They exhibit traction motors of a compound regenerative type for railways, tramways and automobiles. These motors regulate entirely by counter-electromotive force, all armature resistances being dispensed with. They also act as dynamic brakes, in which capacity they return *to the line* in useful work the major portion of the moving energy of the car, whether on descending grades or in arresting momentum. Supplemental electric brakes are employed, but only to bring the car from a slow-walking speed to a final stop. All control, both in accelerating and retarding, is effected through a single controller handle. The Johnson-Lundell surface contact system is shown at this stand and claims to have a combination of the good qualities of the magnetic "Pick-up" principle, and those of the electro-magnetic switch. The magnet on the car is not called upon to operate the necessarily heavy switch which supplies power to the car, but does so through the medium of a small interposed relay. This relay closes a circuit of 1 ampere, 50 volts, and in turn operates the electro-magnetic switch. This permits of the hermetical sealing of the switch terminals instead, as heretofore, of bringing them to the surface where they are of necessity exposed to the chance influence of vagrant or leakage currents. Each principle is thus employed for that function for which it is specially adapted, and neither is employed in the respective capacities in which each has hitherto failed.

**Messrs. Hurst, Nelson & Co., Ltd.**, of Motherwell, show a double-decked four-wheel motor car of their improved type, arranged to seat 57 passengers, having extended canopies with access to roof by wide staircases, and improved outside dry seats. Patent life-guards are fitted on each end of the car. The body is mounted on the Hurst-Nelson A1 type cantilever truck, riding on carriage springs and having patent roller bearing axle boxes. They also exhibit their B1 type patent maximum traction truck having a wheel base of 4 ft. with 30-in. driving and 20-in. trailing wheels. It has swing bolsters riding on coil springs, which are designed to take all strains and to give easy riding, and an improved brake is fitted on the truck; the car body can be carried as low as on a four-wheel truck. The Hurst-Nelson patent sand valve, fitted with hopper, is shown ready for use. This valve has been largely and successfully adopted. Their improved truck-brake blocks which allow of the maximum amount of wear, and are readily removed and fixed in position, are on exhibition, also two of their patent automatic couplings, which are designed to allow cars to take all curves, are shown coupled together. Their patent roller bearing, and ordinary bearing axle boxes are shown fitted with latest improvements, also their destination indicator, fitted with coloured signal lights. These indicators can be worked by hand from the platform of the car. The trolley standard, foot gongs, brake spindle and handle, roof lamp standard, and sand release gear, as made at the Motherwell Works, are all on view.

**The Chloride Electrical Storage Co., Ltd.**, of 39, Victoria Street, S.W., and Clifton Junction, have a comprehensive exhibit of accumulators, and are showing many sample cells as duplicates of batteries actually supplied for traction and power purposes. One does not anticipate at this time of day any striking novelty in the design or construction of the lead storage battery, and it is perhaps as well for the peace of mind of those engineers whose duty it becomes to take charge of accumulators, that once a manufacturer turns out a satisfactory standard article, he should, unless a good and sufficient reason arise, confine himself to making to standard, instead of continually altering this or that detail, to the confusion and annoyance of the purchaser when repeat orders or renewals are necessary. The expectation, therefore, of seeing the Chloride Co.'s standard plates at still another Exhibition is realised, and a large assortment is shown, ranging from little plates about 4 in. × 3 in. to very large ones about 36 in. × 18 in. That the same principle of construction is adhered to for all sizes argues well for economical production. It seems probable that with the double C R type plate as shown, the limit of size has been reached. With present requirements this plate is amply sufficient to give any ampere-hour output necessary, without taking up an inordinate amount of floor space, which is an important desideratum in housing a battery in any position where only limited accommodation is available. The very considerable depth of the boxes has not, so the makers inform us, caused any trouble through inequalities of the specific gravity of the electrolyte, as this type of cell is most frequently installed under conditions which necessitate high working rates, thus obviating any difficulties in this direction. For power work, the accumulator of to-day has to respond to practically any demands made upon it, and the Chloride Co. are supplying cells for this purpose capable of discharging at the half-hour rate. The peaks on a traction load are not, of course, of this duration, but it frequently occurs that after a heavy peak discharge the load falls off rapidly, and the battery is immediately being charged at almost as heavy a rate as it was just previously discharging. This condition of affairs levels up the load on the generating plant, and it is

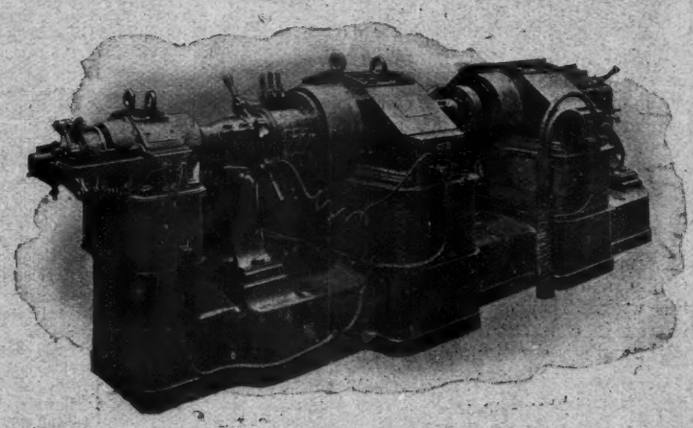
possible to run at a constant load during the whole period of its operation by connecting the battery in series with a Highfield booster. A machine ("B" size) capable of dealing with momentary peaks of 400 amperes on a 550-volt circuit is exhibited, and some interesting particulars as to its performance are available. This booster differs from the ordinary reversible booster in that it not only raises the voltage of the battery on discharge, and so relieves the generating plant of the peaks of the load, but it also automatically charges the battery when the line current falls off, to such an extent as will maintain a constant load on the engines without reference to the variations of the line requirements. With the ordinary reversible booster the maximum rate of charge is adjusted by hand; full advantage cannot, therefore, be obtained of a heavy charging current when the load on the line falls off, and it is not possible to maintain a constant load on the engine by this means. With the introduction of numerous systems for producing cheap power gas a large field for electric transmission will be opened up, and with gas engines driving generators on a widely fluctuating load, some such device for preventing the gas engine from being pulled up with an overload will be essential.



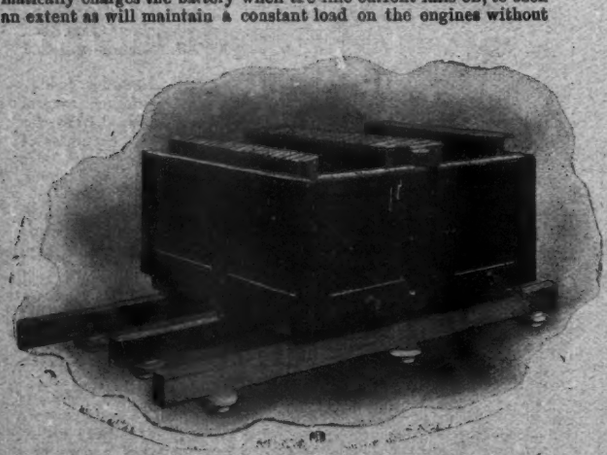
Booster Panel.

The Highfield booster, moreover, maintains a constant line voltage as well as a steady load, and, in some circumstances, a constant voltage would be the more valuable of the two, notably where large gas engines working with poor gas are running on a lighting load. The Chloride Co.'s exhibit exemplifies the trend of modern practice in storage battery construction and utilisation.

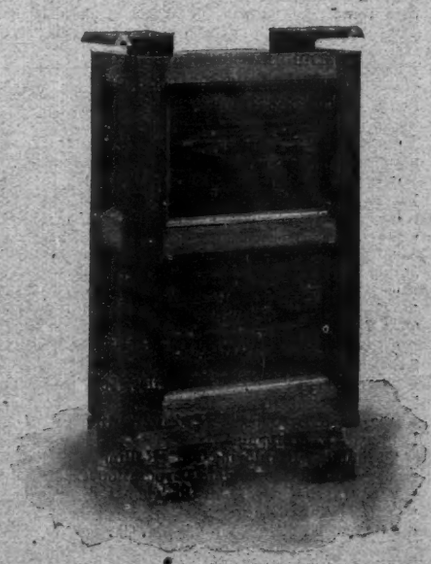
**The Electrical Power Storage Co., Ltd.**, 4, Great Winchester Street, E.C., and Millwall, E., show various types of cells, from the smallest portable battery to large central station cells weighing over a ton each. Various cells of the P type, for lighting and tramway work, are shown, particularly three 74-plate cells, having a capacity of 1,800 amperes for one hour, and an X P 17 double-plate cell having a capacity of 800 amperes for one hour. The latter cells are specially designed for stations whose floor space has to be economised as much as possible. The O K type for large power stations is shown. It is a larger type than the above, and is also designed to economise floor space. The cell shown, O K 17, is capable of giving 900 amperes for one hour, or 430 amperes for four hours. Various samples of the company's L, K, W S, and W T type are exhibited mounted in glass boxes. The W S type is a lighter model of the P type, and is serviceable for smaller central stations, isolated plants, &c. The W T is a special type, similar to W S, but arranged so as to be suitable for low boxes. The K type is largely used in private-house installations, and by British and Colonial post offices for telegraph work. The L type is useful for low discharges over long periods. It is largely used in the smaller private house installations. Specimens of the W T type are shown in wood boxes specially designed for ship-lighting, also some large K and L type sections. Faure-King cells are shown in ebonite boxes—these are extensively used for motor car work; and E type, which is used for electric launches. Various specimens of the company's B and V type cells are exhibited; these are much used for portable and semi-portable work respectively. The company also show samples of their various plates.



Highfield Booster.



Chloride C.R. Type.

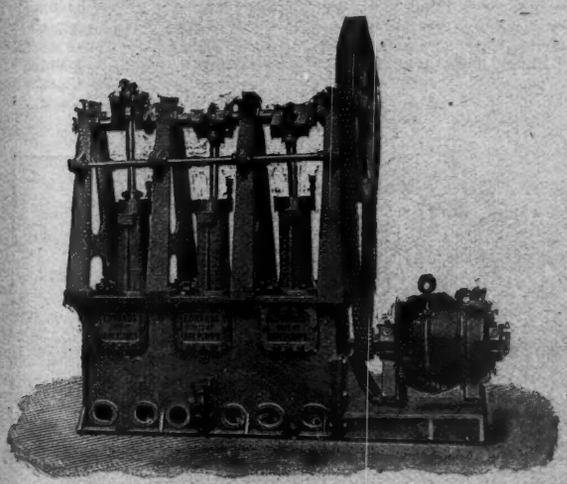


Chloride Double C.R. Type.

**The Kingsland Electric Traction Syndicate**, of 8, Bream's Buildings, Chancery Lane, E.C., have placed before us an advance copy of their new pamphlet relating to their mechanical surface contact system of electric traction. This system has already been

described in our columns (see ELECTRICAL REVIEW for May 10th and 17th, 1901), and visitors to the Tramways Exhibition will find an exhibit of it at stand No. 171 in the West Gallery. The pamphlet, copies of which may be obtained on application, contains a very full description of the Kingsland system, accompanied by photographic and diagrammatic illustrations of the different parts. The Wolverhampton experimental line, of which a photographic street view is given, is about 200 yards long, and comprises a straight portion, a curve of 60 ft. radius, and a right and left hand turn-out.

**The Edwards Air Pump Syndicate, Ltd.,** of 3 and 5, Crown Court, E.C., are exhibiting on Stand No. 108 a set of three-throw air pumps of their patent type, driven by a Bruce Peebles motor. That the Edwards pump has found favour with electrical engineers is understood from the fact that it has been fitted in more than 80 of the leading electric lighting and traction stations, amongst the most important being the City of London, Glasgow, Liverpool, Manchester, Salford, and Newcastle-on-Tyne. The Edwards pump is well adapted for running at high speeds, and in many cases the motors have been direct coupled to the pump crankshaft. When, however, it is desired to fit a very high-speed motor to a set of pumps, it is advisable to reduce the speed by means of gearing. Several different methods can be adopted, and in the set of pumps shown, the speed reduction is accomplished by means of a Hans



EDWARDS AIR PUMP AND BRUCE PEEBLES MOTOR.

Renold chain and wheels, as shown in the above illustration. In the Edwards pump, foot and bucket valves are entirely dispensed with. The only valves used are those which, in the old type of pump, are known as the "head" valves, and these are readily accessible by removing the door at the top of the pump. Thus one of the principal causes of breakdown and delay, viz., the giving way of inaccessible valves, is entirely removed, and as there is but one set of valves to renew, instead of three sets, a considerable saving is effected in maintenance charges and the time necessary for overhauling. Another important feature in the Edwards air pump is that the water is dealt with mechanically, and as, consequently, the speed of the water must correspond to the speed of the bucket, a regular quantity of water is assured for each revolution of the pump, and the sudden flooding which frequently takes place when the old type of pump is run at high speeds is avoided. The efficiency of the Edwards pump is also increased by the provision of clear air inlets, and by the reduction of the top clearance to a minimum. It is equally suitable for surface evaporative or jet condensers.

**The British Schuckert Electric Co., Ltd.,** of Clun House, Surrey Street, W.C., have an exhibit of their surface contact tramway system, of which we gave an illustrated description in the ELECTRICAL REVIEW for February 15th and 22nd, 1901. They show a complete roadway contact stud and section of track rail mounted on sleepers; a small motor for working the slide contact; also a switchboard complete with contact apparatus shown in operation, and illustrative of the inter-connections between switch gear, and the operation of the safety devices employed. The separate parts of the underground current supply are shown at the stand by means of photographs. It will be remembered that the company issued a beautifully set out *brochure* some time ago tracing the development of electric traction systems, notably conduit and contact tramways, leading up to the Schuckert Munich line installed in 1899. No doubt anyone taking a special interest in the system can obtain a copy of this publication from the above address.

**The Sturtevant Engineering Co., Ltd.,** of 147, Queen Victoria Street, E.C., and Bankside, S.E., have arranged an imposing stand, whereon a large quantity of Sturtevant apparatus is exhibited, also a collection of photographs illustrating induced draught plants, Sturtevant electric fans, and generators and motors. There are four Sturtevant C.H. self-starting rheostats, by the use of which motors can be started and stopped automatically from a distance. The examples range from 3 H.P. to 10 H.P. The Sturtevant C.H. multiple solenoid pump starting rheostat is automatically controlled by means of a float switch, thereby enabling a practically constant level of water to be maintained in the tank to which the pump is delivering. Four C.H. electrically operated main switches are shown, fitted with blow-out magnets, and these range from 75 to 520 amperes capacity. Also the following:—One C.H. double-lever type motor-starting rheostat with automatic no-load release, and overload circuit-breaker, 10 H.P., 220 volts; one C.H. double-lever type motor starting and speed regulating rheostat, with automatic no-load release and overload circuit-breaker, 7½ B.H.P., 220 volts; one C.H. quick-break reversing switch for use in connection with electric lifts, &c.; one D.P. float switch for use in connection with the Sturtevant C.H. self-starting rheostats; two C.H. automatic pressure regulators, suitable for use in connection with the self-starting rheostats when these are to be installed in connection with pumps maintaining a pressure of air, water, or gas in a receiver. Also one C.H. motor starting and field regulating rheostat, 10 B.H.P. 220 volts. This enables the motor to be started up properly, and the speed to be increased considerably above normal, and, at the same time, prevents the possibility of the motor being started with a weak field. One C.H. multiple switch starting rheostat with interlocking switches and automatic no-load release, 500 B.H.P. 220 volts, suitable for use with very large motors, and enabling the motor to be started up without the possibility of sparking at the rheostat. One C.H. motor starting and reversing rheostat with automatic no-load release. One C.H. electric printing press controller with low speed gear, and arranged for starting and stopping from a distance. Two Sturtevant C.H. reversible drum controllers suitable for use with electric cranes and hoists. Two C.H. reversible drum controllers for electric cranes and hoists, specially arranged to control the speed between normal and 10 per cent. of normal, regardless of the load on the motor. One C.H. non-reversible drum controller for printing presses. One C.H. reversible drum controller for printing presses arranged to control the speed between 50 per cent. below normal and 25 per cent. above normal in either direction. One C.H. interlocking theatre dimmer with worm gear and master lever, giving complete control over the lights in a theatre; and one C.H. safety motor-starting rheostat, universal type, with automatic no-load and overload release, main switch, and maximum and minimum automatic magnetic circuit-breaker. This is a rheostat which may be placed in the hands of the most careless or ignorant motor attendant, and yet, it is claimed, will absolutely protect the motor against damage either from electrical causes or from careless or improper usage. A number of Sturtevant fans are also to be seen on this stand, including the Co.'s No. 2 Monogram blowing fan, with up discharge; No. 5 Monogram exhausting fan, with bottom horizontal discharge; No. 8 high-pressure fans; No. 40 steel-plate fan, with direct-connected steam engine. The No. 50 steel-plate fan, with direct-connected electric motor, is specially designed for ventilating, drying, mechanical draught for boilers, &c., and for general land and marine work. The self-contained and compact nature of the apparatus renders it particularly adapted to modern requirements. The eight-pole magnet ring of the motor is centred within and attached to lugs projecting from the casting, which is in turn bolted to the fan side, while the fan itself may be given such shape and dimensions as to exactly meet the requirements of any particular case—that is to say, it may be arranged to discharge at any desired angle, and to bolt against a vertical wall or bulkhead without in any way impairing its efficiency. The Sturtevant 48-in. electric propeller fan is also shown.

It is interesting and instructive to watch the demonstrations conducted at the booth of the **Standard Varnish Works,** whose London offices are at 23, Billiter Street, E.C. The American managers of the company sent over their electrical expert, Mr. John C. Dolph, from New York, in order to take charge of their exhibit at the Agricultural Hall. The demonstrations are being conducted according to the latest approved method of American shops, and those who are interested in electrical insulation will find this exhibit worth a visit.

The stand of **Messrs. F. H. Lloyd & Co., Ltd.,** of James Bridge Steel Works, near Wednesbury, consists of points of several descriptions for electric traction, drains, and drain boxes for draining the permanent way, and some interesting examples of steel work for cable or conduit tramways. Messrs. Lloyd also exhibit a patent movable point which is operated by the driver, doing away entirely with the labour caused by shifting points.

**The Vacuum Oil Co., Ltd.,** of York House, Norfolk Street, W.C., have on exhibition a very complete line of high grade mineral lubricating oils, manufactured by their special vacuum process of low temperature distillation, and also various grades of lubricating greases, suitable for tramway and light railway work. They make a speciality of their Hecla cylinder oil, to be used with superheated steam, and also of vacuum turbine oil, for use on steam turbines of the Parsons and other similar types, which are now becoming so popular for generating stations. Cabinets and filters are also exhibited.

The exhibit of the **Empire Roller Bearings Co., Ltd.,** of 1, Delahay Street, Westminster, S.W. (Stand No. 9), comprises a good showing of these well-known roller bearings for railway rolling stock and electric tramway cars. We have received a copy of a paper on roller bearings, by Mr. Thomas W. How, and a copy of the company's pamphlet. We understand that the company have secured contracts for fitting roller bearings to Croydon Corporation Tramways, Indian State Railways (under Sir Alexander Randel and Co.), Southport Tramway Co., and for the Crown Agents for the Colonies for West African Railways.

**Messrs. Everett, Edgcumbe & Co.,** of 151 and 152, Great Saffron Hill, E.C., at stand No. 172 (in the Western Gallery), show in operation their new rotary synchronisers for paralleling alternators, which we described fully in our last issue. They further exhibit tram-car recording ammeters, incandescent lamp testers, portable standard testing sets, watt meters (switchboard and portable types), phase indicators, direct-reading ohmmeters,

portable direct reading insulation meters, special tram-car ammeters, &c.

**Messrs. Mellowes & Co.**, of 28, Victoria Street, S.W., and Corporation Street, Sheffield, have an exhibit of their patent "Eclipse" system of roof glazing which is being used for covering various electrical power stations, car sheds, factories and other buildings on account of its water-proof and dust-proof qualities Sheffield, Glasgow (Pinkston), Rhyl and Hammersmith are among the electricity works where it has been employed.

**Callender's Cable and Construction Co., Ltd.**, of Hamilton House, E.C., have on view samples of the ordinary standard types of their cables, including single-conductor, concentric, triple-concentric, twin and three-core insulated with bitumenised fibre, impregnated paper, and with Callender's well-known speciality vulcanised bitumen di-electric; also samples of special cable for crossing harbours and tidal waters, as laid at Cork, Lymington, Lowestoft, Swansea, Whitby, and elsewhere. Further, they exhibit samples of their solid system in iron troughing, in earthenware troughing, and in wooden troughing; also samples of tramway and lighting feeder pillars, of a tramway feeder pillar with removable case to facilitate working the switches, of various kinds of underground boxes, sectional samples of cables, samples of jointing accessories, and of Callender-Webber conduit.

**Messrs. Lewis Berger & Sons, Ltd.**, of Homerton, N.E., have a stand set apart for a specially prepared series of painted panels produced from their different grades of coach and car paints, also a selection of dry pigment colours and varnishes for the trade.

**The St. Helens Cable Co., Ltd.**, of Warrington, exhibit all kinds of cables, both paper and lead-covered, vulcanised rubber, dry core cables, flexibles, cotton-covered, &c., and make a special point of their "Dialite" bitumen insulated cables, by showing a large number of sample coils displayed working in water without lead, and with horn lead sheathing. Mechanical rubber goods, such as cab tires, brake blocks, switchboard mats, &c., are also shown by this firm.

**Messrs. A. Haacke & Co.**, of Homerton, N.E., show their well-known boiler covering, which is doing service in a large number of lighting and traction power stations in all parts of the kingdom.

At Stand No. 73, **Messrs. C. Brawn & Co.**, of 3, Adelaide Street, Charing Cross, W.C., show their patent dry seats and apron frames for tramcars, &c.

**Mr. Sam Deards**, of Victoria Works, Harlow, Essex, and 34, Old Broad Street, E.C., is exhibiting his patent "self-locking" glazing system for the roofs of all kinds of engineering works, electric power stations and tramway car sheds. It is guaranteed not to cause fracture of glass after once it is fixed, as some systems do where nuts, bolts, or screws are used to hold down the loose caps. The "self-locking" bar is specially adapted for glazing on iron roofs, and saves all drilling of holes in the iron purlins, and, as no woodwork is necessary, the whole structure is made waterproof as well as imperishable. The lead-covered bar has a separate lead cap, so that, if necessary to repair the glass, the lead cap is easily removable without damaging the lead-covered bar.

**Messrs. E. Green & Son**, of Exchange Street, Manchester, show one of their patent fuel economisers containing 96 heating tubes (about 1,000 sq. ft. heating surface). The scraper motion is actuated by a 1-H.P. motor fitted on the gearing frame, and the economiser is constructed for high pressure, the top boxes being fitted with internal lids. This is the type of economiser Messrs. Green are supplying to all electric lighting and tramway power installations throughout the country, and only recently the firm received the largest order on record for economisers, amounting to 10,000 tubes, for the Metropolitan and District Railway. At the Wolverhampton Exhibition Pavilion, by the way, they are showing an economiser of 192 tubes in three groups.

**Le Carbone**, of 36, Lime Street, E.C., and Levallois-Perret, Paris, &c., exhibit a large number of types and qualities of carbon brushes, bearings, bushes, contacts, &c. Tram motor brushes make quite a large section of their exhibit. They have specialised in tram work, and number among their clients the principal tramway and light railway undertakings of the kingdom. They make, too, a display of primary cells for bells, signals, telephones and telegraphs which present several novel features. The "Leclanché" type of cell has been a very good servant to the telegraph and telephone engineers, but there are many applications for which it is quite unsuitable, and Le Carbone, while maintaining in several of their cells the elements of the porous pot form of cell, modify them considerably with a view to a more extensive use of this description of open circuit cells. Among their well-known types of cells are the "Lacombe" and "Sanspareil," and comparatively new ones are the "Carbo" and "Paris" cells, the great features of the latter being its portability and the ease with which each component can be taken apart and renewals effected when necessary.

**Messrs. Joseph Kaye & Sons, Ltd.**, of Leeds, exhibit their patent railway carriage wedge lock with patent safety catch, with patent inside and outside handle. These locks are now being adopted by most of the leading English railways. They also show their latest patent automatic sliding door latch, for railway and tramway sliding doors, as used by the Great Eastern and North-Eastern Railways, also on 38 of the latest tramcars recently supplied to the Leeds City Corporation. Their well-known oil cans for oiling machinery of every description, including locomotives, automobiles, &c., and their patent fare collectors, which are successfully employed on the Leeds City tramcars, are also in evidence.

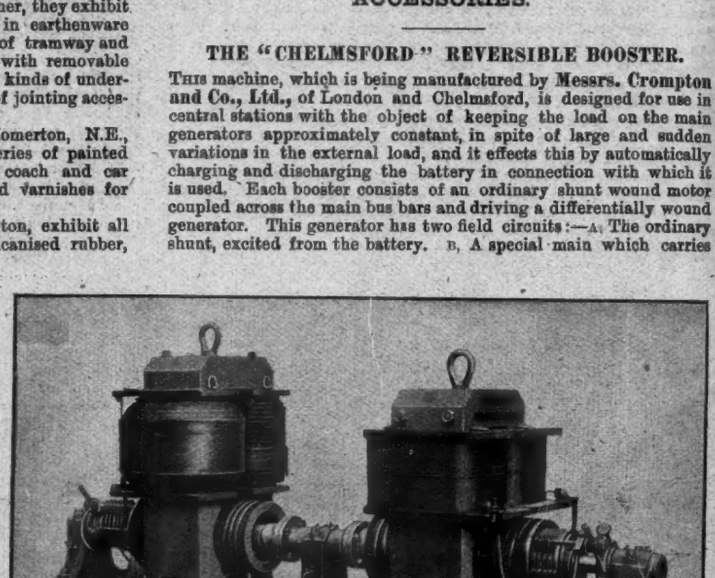
**Messrs. Reavell & Co., Ltd.**, of Ranelagh Works, Ipswich, have one of their small electrically driven compressors which is exhibited on the B.T.H. Co.'s stand with a B.T.H. motor.

*(To be continued.)*

## ELECTRIC TRACTION MACHINERY AND ACCESSORIES.

### THE "CHELMSFORD" REVERSIBLE BOOSTER.

This machine, which is being manufactured by **Messrs. Crompton and Co., Ltd.**, of London and Chelmsford, is designed for use in central stations with the object of keeping the load on the main generators approximately constant, in spite of large and sudden variations in the external load, and it effects this by automatically charging and discharging the battery in connection with which it is used. Each booster consists of an ordinary shunt wound motor coupled across the main bus bars and driving a differentially wound generator. This generator has two field circuits:—A, The ordinary shunt, excited from the battery. B, A special main which carries

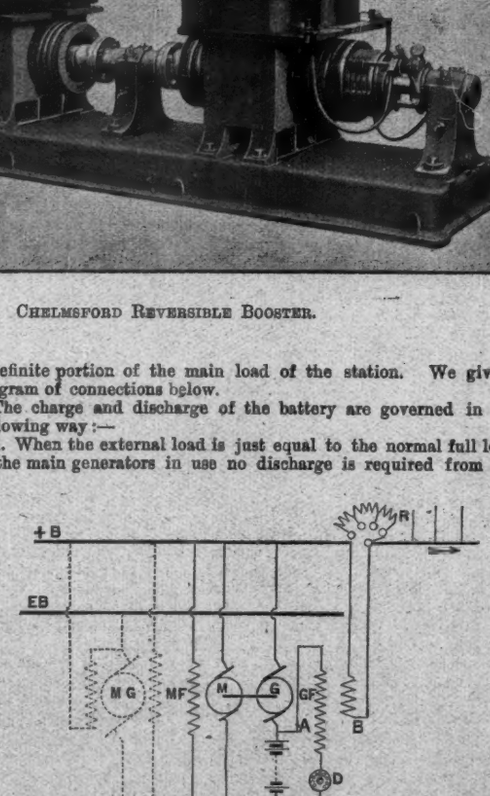


Chelmsford Reversible Booster.

a definite portion of the main load of the station. We give a diagram of connections below.

The charge and discharge of the battery are governed in the following way:—

1. When the external load is just equal to the normal full load of the main generators in use no discharge is required from the




± B, Bus bar; E B, Equalizer bar; M G, Main generator; M and G, Motor generator; M F, Motor field; G F, Generator shunt field; B, Bye-pass resistance; A, Shunt winding; D, Rheostat; B, Main winding.

Diagram of Connections for Chelmsford Reversible Booster.

battery, and the field windings are so designed that under these conditions the excitation due to the special series coils neutralises the excitation due to the shunt winding.

2. When the external load is greater than the normal load of the main generators, a discharge current is required from the battery.

This discharge current is automatically obtained, as the increased current in the external circuit increases the excitation due to the series coils, and the connections to the battery are such that the volts thus given by the generator are added to the battery.

3. When the external load falls below the normal full load of the generator the reverse action takes place, the shunt winding, A, overpowering the excitation due to the series coils, reversing the polarity of the generator, and causing a charging current to pass through the battery.

To take a special example:—We will assume that the battery is being used in connection with a tramway circuit at 500 volts. Under condition (2) where the battery is required to discharge, the booster should be designed to add about 40 volts when the battery is discharging at its maximum output, and give about 40 volts in the reverse direction when the maximum charging current is passing to the battery under condition (3). The switch, B, is used in connection with a compensating resistance, shunting the generator series coils. This switch has a double function:—(1) It allows a varying number of main generators to be used in parallel. (2) It enables the point of reversal to be adjusted. Further, a shunt regulator, D, is provided in the generator shunt circuit.

The above describes the normal conditions under which the booster works automatically. In practice the machine is also required for fully charging the battery at certain times, and taking the examples given above, the booster will have to be large enough to give 120 volts occasionally. These higher voltages are obtained by short-circuiting the series coils and regulating the volts by the ordinary shunt resistance (D). Under these conditions the machine acts as an ordinary motor-booster. Motor-generators of this type have been supplied to Birkenhead Corporation, Mount Morgan and Yarmouth, and others are in hand for Norwich and Rothesay. They are particularly useful in tramway stations on account of the rapidly varying load.

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We understand that **Messrs. R. W. Blackwell & Co., Ltd.,** have just completed a record piece of overhead work by equipping the last section of the Liverpool Corporation Tramways in less than three weeks. The line in question extends from the Old Swan to Knotty Ash, and necessitated the supply and erection of 2¾ miles of trolley wire, 90 poles with 22-ft. brackets and cast-iron fittings. The orders for the poles and fittings were placed on May 31st, and the order for the complete equipment on June 3rd. The poles were delivered on June 2nd, the brackets and bases by the 16th, and the actual work of erecting the line was commenced on that date. The whole of the work was completed and passed by the Board of Trade on June 23rd, and it was therefore possible to run cars over the line within 20 days from the date on which the order was placed. This section brings up the total overhead line work erected in Liverpool by Messrs. Blackwell to 100 miles. The whole of the work was carried out to the designs and under the supervision of Mr. J. A. Brodie, the city engineer, who has had so much previous experience of tramway work in Liverpool.

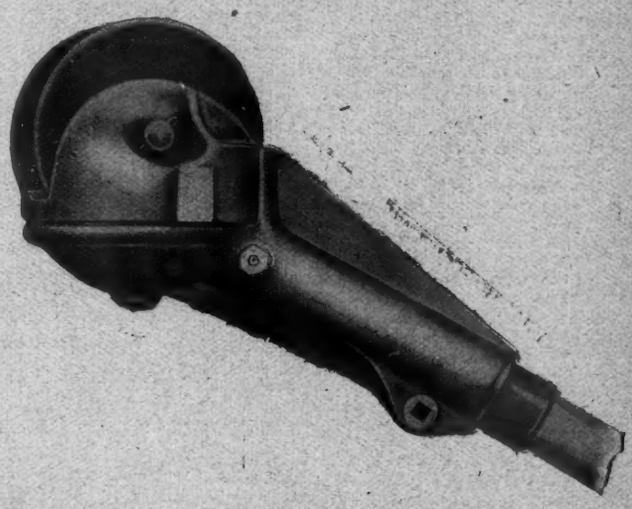
**Messrs. Ashmore, Benson, Pease & Co., Ltd.,** of Stockton-on-Tees, have sent us a list with an illustration of the last battery they have erected for electric traction service. This battery is used by the Devonport Corporation for supplying current to the Devonport, Stonehouse and Plymouth Tramway Company for regulation of the voltage on the trolley line. It was erected a few months ago. There are 280 cells of a capacity of 150 amperes for 10 hours. The total weight is 120 tons.

**Mr. Alph. Steiger,** of 28, Victoria Street, S.W., has secured an order for a turbine for the electric lighting plant of a private residence, which will utilise a fall of only 30 in. to 3 ft. He also has similar orders in hand for Escher, Wyss & Co.'s patent universal governor to regulate low-fall turbines for electrical work.

**Messrs. Korting Bros.,** of 53, Victoria Street, S.W., have sent us a descriptive catalogue of their ejector condensers, with notes on spray cooling; also a price list of their "Schutte" automatic exhaust relief valves, which we understand are now finding an extensive application in electric lighting and power stations.

**The Edison & Swan United Co.,** of Queen Street, E.C., are supplying large quantities of their latest form double filament series traction lamp to Glasgow and other leading electric tramway systems. It is the outcome of considerable experience in the practical working of lamps used for this purpose under varying conditions, and as such it has met with a very considerable amount of patronage.

List No. 1 (1902) issued by **Messrs. Brecknell, Munro and Rogers,** of Thrissell Street, Bristol, contains details and illustrations of a large number of their electric traction supplies, trolley standards and heads, overhead line fittings, insulating material, car and truck spare parts, also track and repairing tools are described and well set out, and purchasers of tramway details will find the list of service to them. Their trolley standard consists of a steel mast with a flanged base for attachment to top deck of car, and the head or bonnet is of malleable iron fitted with a lap-welded steel tube, and mounted on a ball bearing on the masthead. It also carries a screw stop which prevents the standard making a complete revolution, or at will, this screw may be adjusted so that the head may revolve through a full revolution; a swivelling contact is fitted when required. A weather guard is provided which efficiently protects the internal parts in all positions. The compensating lever is of malleable iron fulcrumed in the head or bonnet upon a mild steel pin. The connecting rod is of Farnley iron with a solid welded eye at base, coupled to a malleable cast guide block sliding in the steel inner tube. The connecting rod is secured to the compensating lever at upper end upon a steel swivelling pin and nut and lock nut. The coil spring is in one length, and its section is so designed that the maximum reaction is given off upon a minimum compression. A steel collar is rivetted inside the steel inner tube against which the spring rests when under compression. The pole, or trolley boom, is of steel, manufactured upon an improved principle, and guaranteed to give the best results obtainable upon any given section. It is properly insulated from the trolley standard and taped in the usual way, unless special insulation is specified. There is an easy lead for the cable, which is provided with a rubber covering where it passes from the end of boom into the standard, and also where it passes through the malleable cast guide block in the bottom of the standard. The effective leverage of the compensating lever varies automatically, and may be so adjusted with the spring as to preserve a uniform pressure within a given angle, and when the pole is depressed below that given working angle the upward pressure decreases rapidly until the pole is below the horizontal; if further depressed, the pole reaches a position in which the parts operating are nearly in equilibrium. The pole can be lightly held in this position, and the head is easily accessible for examination. This position is attained when the trolley head is about 2 ft. 6 in. below the top of the mast. The limit of the working angle may be varied so as to embrace the lowest working position at which it may be desired to set it; for instance, a low railway bridge where the wire is necessarily comparatively rigidly fixed. The pressure at this point is reduced to a minimum so as to avoid excessive friction and undue wear of the trolley wire and suspensions, and to relieve the trolley boom of the great bending strain which it otherwise would have to withstand, which bending strain causes a large deflection of the pole, and necessitates straightening, in many cases putting a short period to the life of the boom. It has been found that upon systems where excessively low bridges have to be encountered the trolley booms, wire and fittings are not subjected to any increased wear or strain, on account of the limited height available for the line, when this standard is used, as against a rapid deterioration of the parts named where no means is provided for automatically reducing the pressure at such portions of the line. As we recently mentioned, these standards are in use in quite a number of places in the provinces. The trolley head, manufactured by the same makers and illustrated herewith, is of very light weight, weighing only 6½ lbs. complete with insulation. Both the wheel pin and the swivelling bearing are automatically lubricated from a reservoir formed in the wheel. A thin, clear machine oil is used, and centrifugal force is utilised in feeding the bearings, yet, curiously enough, it is only when the wheel stops that a very small drop of oil is delivered into the duct leading from the reservoir to the work. These trolley heads are in satisfactory daily use on a number of street railways in Great Britain, running steadily through the most complex overhead work without giving trouble. In the A-size head the wheel is 3½ in. diameter, and in the B-size head 4½ in. diameter. The wheels run on hardened steel pins, and have an average life of 5,000 miles; they have been tested and ascertained to run 1,000 miles with a single charge of lubricant. It is, however, found convenient to give these heads a charge of oil once every week end when in the depôt, which will suffice for the next seven days.



Brecknell's Trolley Head.

**Electro-motors, Ltd.,** of Openshaw, Manchester, have issued a June, 1902, price list of their electric motors for continuous currents. The list is most neatly got up, and gives descriptive details and tabulated data of standard and low-speed motors for low and high voltages. The illustrations show the motors fitted with patent worm-reduction gear, and direct coupled to a pump. A telegraph code and weight and dimension details are given in table form at the end.

*(To be continued.)*

## THE SCHMIDT SYSTEM OF SUPERHEATING.

Though it is over 40 years since the use of superheated steam appeared likely to become common in this country, practically nothing has been accomplished until within the past 10 years. In Alsace, however, where coal is expensive, the art of superheating has kept pace with the practice of compounding that seems to have killed superheat with us. It was a little unfortunate that compounding was so very successful. There is not so very much in compounding except that it coincided with the ability to use higher steam pressures, exactly as triple-expansion was found desirable when the modern ribbed furnace rendered still higher pressures possible. Superheat showed up the villainy of tallow. We seem to remember dreadful stories in respectable engineering journals of the evil effect of high pressure steam on cast-iron, and we have seen plenty of these so-called "effects" which, after all, were the effects, not of steam, but of fatty acids. Compounding survived, however, and superheat died, or, rather, slept. To-day it is understood that a cast-iron cylinder will work with steam hot enough to melt lead, if lubricated with a little graphite and mineral oil, and the results claimed for superheat of about 350° above the temperature of saturation are remarkable—the steam consumption of a triple-expansion engine, with a boiler pressure of only 129 lbs., being 18·3 lbs. per kw.-hour of output. A noteworthy feature of tests made over a wide range of power appears to show that the losses by cylinder condensation are eliminated, or nearly so, and it is, of course, these losses that make one steam engine less efficient than another. The supposed absolute zero of temperature being 459° F., what is the theoretical effect of raising the temperature of working steam from 350° to 700°, where the exhaust temperature is, say, 119°, or 578° absolute?

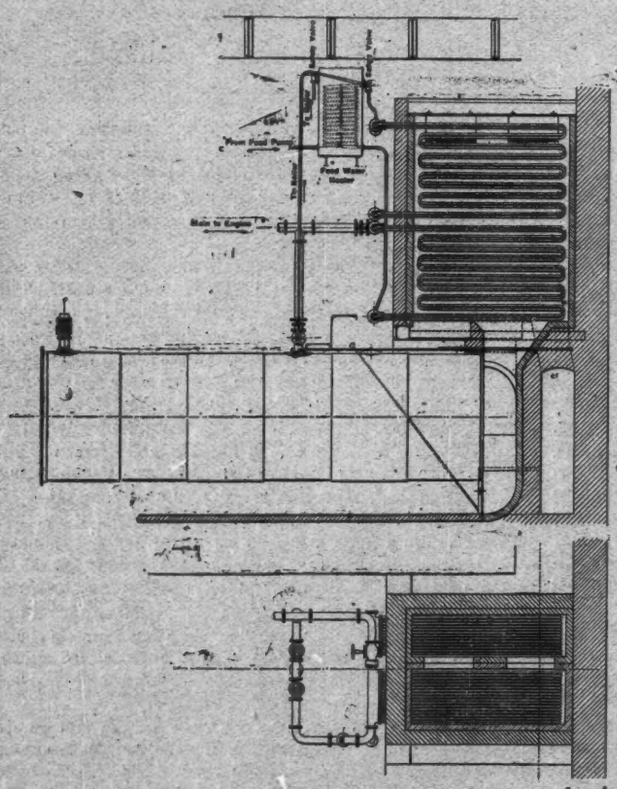
In one case the absolute initial temperature is 809°, in the other it is 1,159°. The expression $\frac{t_1 - t_2}{t_1}$ becomes respectively

$$\frac{809 - 578}{809} = 0{\cdot}285 \text{ and } \frac{1,159 - 578}{1,159} = 0{\cdot}501,$$

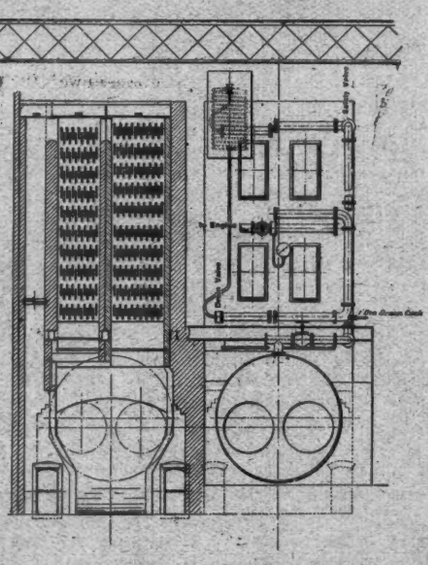
and apparently we ought to expect a much greater economy than is really secured, for the calculation shows an economy of 43 per cent.

But though this high superheat goes towards the H.P. cylinder in the Schmidt system it does not reach it, for it meets first the reheater of the L.P. cylinder, and parts with some of its superheat for the benefit of the steam going to the L.P. cylinder. If we assume that the H.P. cylinder really gets steam at only 500° F., or 959° absolute, the efficiency of the engine will be 0·4 only, and the economy over saturated steam will be a little under 30 per cent. In any case, theory points to an actual economy greater than what obtains, and shows that engineers have become accustomed to attribute less to thermo-dynamic effects than to cylinder action. Even if the H.P. cylinder is supplied with steam at 500°, as assumed, it can hardly be considered probable that this can be regarded as the true initial temperature. Probably much of the added temperature still disappears in warming up the cylinder walls cooled during exhaust and thus, superheat, if moderate, does resolve itself into the prevention of cylinder condensation after all, and its economy is measured by the amount of initial condensation prevented. With high superheat there is some further economy due to the higher initial temperature. In any case a net economy is certain.

In the Schmidt system, of which we give here an illustration showing a superheater fitted to a Lancashire boiler,



Sectional Plan and Elevation of Schmidt Superheater.



Part Sectional Elevation.

the wet steam from the boiler enters the top of the superheater at the end nearest the chimney. It travels against the direction of the furnace gases until it reaches the middle of the heater, when it is taken to the hottest end next the boilers, and this time travels with the direction of the flue gases, leaving at the middle point again for the engine. This system is adopted to prevent the initial tubes of the heater from becoming too hot. The steam finally leaves at about 700° F., and is dealt with at the engine as described. We presume that the temperature of 700° is considered too high to employ in the cylinder, and hence the use of the reheater to transfer heat to the steam about to enter the L.P. cylinder. Of course, if the H.P. cylinder could stand 700°, the steam might just as well go into it so hot, and it would still be just as hot when it entered the L.P. cylinder as it is now after reheating, for all the heat that enters an engine must go right through it or appear as work. There is, therefore, no virtue in the reheater save and except that it puts into the L.P. steam useful heat that is considered to be too much for the H.P. cylinder to bear. That is to say, if the H.P. cylinder could take steam of 700°, such steam would arrive at the L.P. cylinder no colder than it now does.

As matters stand, however, the reheater performs the useful office of keeping the steam hot throughout whilst tempering the otherwise excessive heat of the initial steam.

In tests made of the Schmidt system, the steam entering the L.P. cylinder actually had a temperature of 397°, or nearly 185° above saturation point; yet the indicator diagrams throughout the three cylinders showed expansion curves that coincided very closely with the saturation curve, thus proving that while condensation was prevented there was really little superheat left after dealing with the cooling effect of the cylinder metal, and that in estimating the economy of superheat we may take it to be measured by the prevention of the fault of initial condensation and re-evaporation, and not by the thermo-dynamic results of high temperature only.

As showing the evil effects of cylinder condensation, tests show, with the Schmidt engine at various powers from 140 to 20 KW., that, starting with 18·3 lbs. of steam per KW.-hour at 140 KW., the following figures were obtained :—

At 120 KW., 18·5 lbs.; 100 KW., 18·7 lbs.; 80 KW., 19·4 lbs.; 60 KW., 20·8 lbs.; 40 KW., 24·5 lbs.; 20 KW., 38 lbs. Apparently the engine unloaded consumes about 460 lbs. steam per hour, and a further 15 lbs. per KW.-hour of output.

It need scarcely be pointed out that for high superheat special attention is required in the details of the engine, especially to guard against the expansion of the parts which first receive steam. Thus a piston valve internally supported by a spider is apt to expand at the points where the spider is attached to the body of the valve, which will seize, at these points, in its shell seating. Glands on rods need to be placed well away from the steam, and various other points require attention, all of which are connected, more or less, with the feature of expansion by heat.

The following figures for the output of 140 KW. will be interesting :—

Initial temperature of steam supplied to re-heater 709° F. Temperature of initial steam leaving re-heater 601°. Temperature of intermediate exhaust 286°. Temperature of same after re-heating 397°; the latter figure showing that the steam entered the L.P. cylinder superheated nearly 185°.

The overall efficiency being assumed at 83 per cent., as shown by the indicator, which was probably not far wrong, the steam per I.H.P.-hr. at 140 KW. = 226 I.H.P. appears to be 11·4 lbs., to secure which good result it certainly seems worth while carefully to consider the question of superheating. Of course, in comparing this result with saturated steam trials, allowance must be made for the extra heat units in the steam.

The superheater itself may either be heated by the waste gases, as in the illustration, or it may be separately fired, this being considered the better system for large ranges of boilers. It is so arranged that when the current of steam through it ceases, a valve is opened to admit air to keep the coils cool, and generally the stoking of the fire ought to cease nearly an hour before the engine stops, so that during the last part of the time the superheater simply uses up heat radiated from the heated walls of the superheater chamber.

Our illustration shows a feed water heater in connection with the superheater, and it will be observed that the left half of what might all be taken for a superheater is the economiser, which works with a constant circulation of the same pure water. This goes up to the feed heater coil, gives up its heat to the feed there and returns cooled to the economiser. No scale can thus be formed in the economiser, and as it is always full of water more or less hot, it does not readily gather soot deposit and requires no scrapers.

## CORRESPONDENCE.

### Consulting Engineers.

I have often wondered where all the numerous consulting engineers had their origin, and where men so young had obtained the necessary experience, knowledge, and good judgment especially required in this branch of electrical engineering; they have sprung up like mushrooms. Thanks to Mr. Crompton, we have some light thrown on the genesis of the consulting engineers of the mushroom type. As an old engineer I think Mr. Crompton was not far wrong. I have often rubbed my eyes to see announcements made of the appointment of Mr. So-and-So, A.I.E.E., &c., as consulting engineer for a municipal authority, a name never before heard of in the electrical world; and it would be easy to give instances of such appointments ending in the abandonment of the electrical scheme, in disgust, after the fledgling had muddled and bungled along for a few months, the conclusion of the fiasco arriving with a bill for £1,000, more or less, due to the consulting engineer for his valuable services.

Of course, if municipal authorities engage such men, it is their look out for the consequences. But these fellows don't stick at trifles of etiquette; they do a good deal of canvassing soliciting work, calling on firms uninvited and offering their services, and by every influence competing for work for which many of them are incompetent. A little outspokenness by a man in Mr. Crompton's position is admired by an

**Old Hand.**

### Equivalent Sine Curves.

I am much surprised that my mathematics should be questioned. I really cannot find a more general condition than

$$I_1 \sin(\alpha_1 - \beta_1) + I_3 \sin(\alpha_3 - 3\beta_1) + \&c.,$$

for the simultaneous vanishing of

$$I_1 \sin(pt - \alpha_1) + I_3 \sin(3pt - \alpha_3) + \&c.,$$

and

$$E_1 \sin(pt - \beta_1).$$

**W. G. Rhodes.**

### Motors v. Trams.

In a note in one of your contemporaries, complaint is made that a well-known electrical engineer, who took a prominent part in the deputation to Mr. Balfour, had a few days before given evidence against an electrical tramway in the House of Commons, and apparently favoured omnibuses.

As this probably refers to me, who gave evidence on behalf of the Roads Improvement Association against laying electrical tramrails across the existing Hammersmith Suspension Bridge, but not in the least on the grounds given by your contemporary's correspondent, and as the matter is of considerable interest to the electrical profession, I shall be glad if you will give me space to bring my views before your readers. Some of them may have read my last year's address to Section "G" of the British Association, in which I pointed out that one of the most important problems in modern locomotion is that caused by the congestion of street traffic in our towns, and by the undoubted difficulties which exist in carrying our workers to and from their homes in the country to their places of employment in our towns. I then pointed out that a great deal of mischief might accrue from an ill-considered occupation of our streets by tramways, and gave as one of my reasons that the carrying capacity of a street is not increased, but rather diminished, by laying tramrails in it, and that this is due to the want of overtaking power of vehicles running on rails.

Your readers will see that there are several solutions of this problem of street traffic, but not the least interesting one to them is that of the development of electrically-driven cars or omnibuses to take the place of our present horse-drawn vehicles. Thanks to the efforts of a few electrical engineers who have in the face of great discouragement persevered with their work, we already see considerable numbers of these vehicles running satisfactorily in the streets, and I learn that the next year will see an enormous development of this use of electrical power. It is needless for me to point out how important it is to the electrical industry that this development should have full scope and every possible chance of success given to it. Our electrical supply undertakings will benefit by the charging of these accumulator cars which can be carried out at fixed hours of light load. The construction and simplification of the cars themselves, in the means for charging them and maintaining them at the lowest possible cost, will give a field of employment for electrical engineers, so that even if we take the narrow and selfish view that an electrical engineer should consider his profession first, and the public afterwards, a view with which I personally disagree, I think it can be

shown that the electrical profession as a whole, and certainly the public generally, is likely to benefit to a greater extent by the wide development of electrically-driven vehicles to take the place of our present horse-drawn vehicles, than for electrical tramways to be developed on certain lines of road in such a manner as to hinder the progress of these smaller electrical cars, for no one, not even Mr. Clifton Robinson himself, imagines that electrical tramways can be laid in every street in our towns, and unless this were done it is always necessary to encourage the development of mechanically-propelled vehicles to take the place of the horse-drawn traffic. If the encouraging progress which had already taken place in the development of all classes of mechanically-propelled vehicles continues at anything like the rate attained during the present year, we shall soon find a notable decrease in the number of horses. Our streets will rapidly become cleaner, the surface of the road will not suffer so much from the impact of the horses' feet, the reduced cost of cleaning and upkeep which will follow on this will make it economical, year by year, to increase the number of streets and roads laid with perfected surfaces. Every street which at that time had been laid with tramrails will be dangerous and difficult for use by vehicles having smooth tires, and all such thoroughfares will then be a hindrance instead of assistance to the flow of traffic.

I know that I am not alone in holding these views, but all who agree with me must from time to time find themselves compelled to oppose the indiscriminate laying of tramrails, especially on the old lines of road leading out of London, which are in most cases the only means by which the Londoner can obtain access to the country, or on which garden or other country produce can be brought in. The promoters of these electrical tramlines laid on our lines of road out of London know well that their future profits depend not on carrying the omnibus traffic which already exists, but on stimulating a greatly increased traffic by encouraging new building estates along their line. Thus London is rapidly extended along these lines of road, the traffic on them, other than that carried by the tramcars themselves, is more and more congested, and those living in London thus find themselves further removed from the country scenery and country air. These lines are really railways, and ought to be constructed on land purchased for the purpose.

**R. E. Crompton.**

*July 1st*, 1902.

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### An Undesirable Guest.

Last evening, when just escorting three ladies to the door at the close of the conversazione of the Institution of Electrical Engineers, I was accosted by a gentleman unknown to me, in evening dress, who appeared to be under the influence of liquor. He addressed me by name, and said he wished to tell me that I was a cheeky young cad, whose letters were not worth answering, and that I must take care. He was repeating his insult when I remarked, "I do not know you," and turned on my heel. He was of medium height, with fair hair, and apparently about 30 years old. Would any member who may have witnessed the incident kindly help me to identify the individual, and ascertain who is responsible for his admission?

**Silvanus P. Thompson.**

*July 2nd*, 1902.

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## PARLIAMENTARY.

### Rhondda Tramways.

The Bill of the Rhondda Urban District Council recently came before a House of Lords' Committee, presided over by Mr. Tatton Egerton. The object of the Bill is the construction of electric tramways in the Rhondda Urban District. The promoters were represented by Mr. Balfour Browne, K.C., Mr. Moon, K.C., and Mr. Rhys Williams. For the Taff Vale Railway Company, who opposed, Mr. Pember, K.C., Mr. Fitzgerald, K.C., Mr. Baggallay, K.C., and Mr. Neville appeared. Mr. Page and Mr. Gregory represented several owners and occupiers of property affected by the Bill. The Glamorganshire County Council, represented by Mr. Vesey Knox, petitioned against alterations.

Mr. Balfour Browne, K.C., in opening the case, said the only part of the Bill which was opposed related to the construction of tramways, the petitioners being the Taff Vale Railway, and thus it was merely a railway opposition on the ground of competition. In these days that was about the weakest opposition that could be offered to a Bill giving tramway facilities to an immense population. Tramways were not rejected on mere ground of competition. The proposed tramways would go very near to the bulk of the population. The Great and Little Rhonddas were at present served only by the Taff Vale Railway Company, and as long as 1882 the necessity of some other means of communication was felt, and tramways were promoted in the district, resulting in the local authority now having a fair and open field. The feeling in the district was strongly in favour of tramways, and if the Urban District Council did not make those lines, the British Electric Traction Company would ask for power to do so. The tramways were to be constructed from Blaenrhondda at the top of the valley to Perth. It was also proposed to run a tramway from Mardy at the top of the Little Rhondda down to join the main tramway running to Perth. In addition to the railway opposition, there was that of a small number of frontagers whose fear was that the tramway might carry people away from their shops at the ends of the valleys, but he believed that those people were only the Taff Vale Railway Company in another guise. As to the question of running trams on Sunday, which if it was done would be for the purpose of taking people to places of worship, the Taff Vale Railway Company had stirred up the Nonconformist conscience in South Wales. The question of running cars on Sunday, however, was one for the public in the district to determine.

Mr. Vesey Knox said the Glamorganshire County Council were entirely in favour of the preamble of the Bill, but later would ask for the insertion of a clause as to running powers.

Mr. W. P. Nicholas, clerk of the Rhondda Urban District Council, gave evidence in support of the Bill. He said that with regard to Sunday service of trams, there was a service on the Taff Vale Railway, and the refreshment rooms were opened. The cost of the proposed tramway would be £293,000, and that of the street widening £58,000, but a great deal of the street widening would have to be done whether the tramway was made or not. The Committee adjourned.

On Tuesday last week Mr. Nicholas, the clerk of the District Council, was further cross-examined by Mr. Page on behalf of the petitioning owners and occupiers of property affected. He said the tramway was intended to convey workmen to and from their work, and would not be used to any great extent for the purpose of shopping in Pontypridd. He knew nothing of the allegation that signatories were informed that the District Council only wanted to get the order confirmed, so that after obtaining it the Council might bargain with some private company and thus save the ratepayers a large sum of money.

In answer to Mr. Moon, K.C., Witness said the workmen in the district, as a rule, had an interest in their own houses, and changed their employment more frequently than their houses. The Committee adjourned.

On Monday and Tuesday the Committee resumed its consideration of this Bill, and after hearing a good deal of evidence in support thereof, the Committee adjourned.

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*Pontypridd Tramways.*—On several days last week the Tramways Provisional Order Bill, which confirms an order to the Pontypridd Urban District Council to make certain tramways within their district, was before a Committee of the House of Lords, presided over by Lord Newton.

Mr. Ram, K.C., who appeared for the promoters, with Mr. Moon, K.C., and Mr. Williams, in opening the case, said the order which Parliament was now asked to confirm was entirely supplemental to an order confirmed last year, when the question of tramway communication in the Pontypridd district was gone into by Parliament. Large powers were granted last year to the Pontypridd Urban District Council, but it was then stated that, in order to complete their scheme, the Council would have to come to Parliament again this year. The Council had been prevented last year from laying down their lines through the town of Pontypridd to connect with the line running from the north, owing to the opposition of certain frontagers at the inquiry before the Board of Trade. The Thomas trustees, who opposed last year, had now come to terms with the Council, and had decided to allow the Council to run over their tramroad 30 years, thus connecting Pontypridd with Treforest. The County Council supported the present scheme. The opponents of the order were the Taff Vale Railway and some frontagers in the town of Pontypridd—the tradesmen who objected to the proposed tramlines on account of the narrowness of the streets. The Taff Vale Railway had opposed the Council's schemes in and out of season last year unsuccessfully before the Board of Trade and both Houses of Parliament, and this year already unsuccessfully before the Board of Trade. The opposition of the railway company was based on the ground of competition, but this, the counsel suggested, should not prevent the passing of the Bill.

After a great deal of evidence had been heard, the Committee announced the preamble proved.

*Metropolitan Railway Bill.*—This Bill came before the Chairman of Ways and Means for the House of Commons last week, and there being no opposition, the Bill was ordered to be reported to the House for third reading. By the Bill the Metropolitan Railway Companies seek powers to execute further works, to acquire additional land for the enlargement and improvement of Baker Street Station; to acquire lands adjoining the line for the purpose of generating electricity and for the electrical working of their

undertaking and undertakings in which they are jointly interested with other companies.

*North Staffordshire Tramways Bill.*—The Stoke-on-Trent Corporation and the Hanley Corporation have deposited petitions in the Private Bill Office of the House of Commons, praying to be heard in opposition to this measure.

*Medway and Thames Canal Bill.*—A Select Committee of the House of Commons, presided over by Mr. A. de Tatton Egerton, last week considered the Medway and Thames Canal Bill which seeks to incorporate a company and empowers such company to construct a canal from the River Medway to the River Thames. Clause 39 of the Bill gives the company power to generate, transform and transmit electricity for the purpose of working the traffic upon the canal, and the locks, gates, lifts and other works and conveniences connected therewith, and for lighting the canal and the property of the company. For that purpose the company may lay down along the canal and maintain and use mains, lines and apparatus for transmitting electrical energy. There was a great deal of opposition to the Bill, but none of it was of an electrical character. The Committee passed the preamble of the Bill, subject to certain protective clauses being inserted.

The following Acts have received the Royal Assent:—Electric Lighting Orders Confirmation (No. 2) Act, 1902; Electric Lighting Orders Confirmation (No. 3) Act, 1902; Electric Lighting Orders Confirmation (No. 4) Act, 1902; Brighton and Rottingdean Seashore Electric Tramroad Act, 1902; Derbyshire and Nottinghamshire Electric Power Act, 1902; Newcastle-upon-Tyne Electric Supply Company's Act, 1902; Manchester and Liverpool Electric Express Railway Act, 1902; Cornwall Electric Power Act, 1902; Manchester Corporation Tramways Act, 1902; Middlesex County Council Tramways Act, 1902; Gloucestershire Electric Power Act, 1902; Scarborough Tramways Act, 1902; Erdington Tramways Act, 1902.

## LEGAL.

### Eckersley v. Cox Walkers.

At Darlington County Court, on June 18th, Messrs. Cox Walkers, electricians, of the North-Eastern Electrical Works, Darlington, were sued by the agent of the Rev. W. Eckersley, for £12 19s. 10d., damages for trespass. An injunction was also sought by the plaintiff. The defendants hold a contract under the Corporation for the maintenance of the fire telephone system, and in 1894 they fixed a wire bracket on property owned by the plaintiff. An action for damages was entered, but was settled by the defendants paying the sum claimed. By accident the trespass was repeated, and the defendants, on becoming acquainted with it, at once removed the bracket, but declined to pay any damages. For the defendants it was stated that after the bracket had been removed they sent a man to see if any damage had been done, but he could find none. It was also stated that when the wires were subsequently fixed they were only near one part of the plaintiff's premises, and that leave for wires to cross property they did not touch was seldom asked for.

Judge Templer said that the defendants had not been given an opportunity of doing what any ordinary person would do. Permission, however, was necessary, and defendants were liable to actions of this kind. Few people would bring them, but when they were brought the penalty must be paid. As the defendants had not acted contumaciously in the face of the Court, he would not grant an injunction, and as it was a case of inadvertence, only moderate damages, £1 and costs, would be given to the plaintiff.

### Improper Fencing.

Three summonses for improperly fencing, guarding and lighting electric light trenches, issued by the Broadstairs and St. Peter's Urban Council against the Isle of Thanet Electric Tramways and Lighting Company, Limited, of 74, Cheapside, London, were heard at Margate last week. The trenches had been excavated for the purpose of laying electric light cables, and the proceedings were taken under the Gas Works Clauses Act, 1847. For the defence it was urged that the trenches had been sufficiently guarded and lighted, and that this was borne out by the fact that no one had fallen into them, and no complaint had been made respecting them. The Bench convicted, and imposed a fine of 40s. in each case, with 12s. Court fees, and £2 2s. solicitor's fees.

### Ambler & Son v. The Bradford Corporation.

In the Court of Appeal on Monday, before Lords Justices Vaughan-Williams, Romer, and Stirling, the case of J. Ambler & Sons, Limited, v. The Bradford Corporation was heard on appeal by the plaintiffs from an order of Mr. Justice Joyce dismissing the action with costs. In this case the plaintiffs, carrying on business at the Midland Mills, Bradford, as mohair and worsted spinners, brought an action against the defendants to restrain the defendants from obstructing a stream called the Bradford Beck, and claiming £33,000 damages for injury alleged to have been done to their premises and stock by flooding arising from the alleged obstruction of the stream. The defence was that the sluice gates which it was alleged caused the obstruction to the stream, and which had been erected for the purpose of electric light works, were not responsible for the injury which had been done, the floods being due to a thunderstorm of exceptional severity. In the result, their Lordships upheld the decision of the learned judge, and dismissed the appeal with costs.

### London and Provincial Electric Construction Company, Limited.

Mr. Justice Buckley, sitting for the disposal of company matters in the High Court of Justice on Tuesday last week, had before him a petition by J. W. Vickers, a creditor, to wind up the London and Provincial Electric Construction Company, Limited. Mr. Dunham, for the petitioner, said his client had been settled with, and he asked that the petition might be dismissed without costs. His Lordship consented.

### West India and Panama Telegraph Co., Ltd., v. Cuba Submarine Telegraph Co., Ltd.

In the House of Lords last week, before Lords Macnaghten, Brampton, Robertson and Lindley, this appeal was heard. It was an appeal from an order of the Court of Appeal affirming, with some variations, a judgment of Mr. Justice Farwell. Mr. Haldane, K.C., Mr. R. Younger, and Mr. A. F. Paterson appeared for the appellants; and Mr. T. R. Hughes, K.C., and Mr. W. H. Green for the respondents.

The previous hearings have already been reported in the Electrical Review.

Mr. Justice Farwell gave judgment in favour of the respondents, and, with certain variations, it was affirmed by the Court of Appeal. Hence the present appeal.

On the conclusion of the arguments, the appeal was dismissed with costs.

## CENTRAL STATION BATTERIES.

By STATION ENGINEER.

The accumulator is to-day a recognised factor of economy in central station design.

Much of the prejudice against batteries which at one time existed has died down, and, for small stations particularly, the importance of this portion of the equipment is undisputed.

One great incentive to changing small alternating-current stations to continuous-current working, has been the ease of supplying continuous current from the battery during the hours of light load, without running the plant, and with consequent saving.

There are two main reasons why the accumulator has taken so long to become an essential in central station economy. The first of these is the supposed uncertainty of the life and maintenance of the battery; and the second is ignorance of its management.

For the first of these causes the battery makers have themselves to blame to some extent, principally on account of supplying batteries underrated, and charging too great a sum for maintenance. The fact that batteries have been so underrated is to be regretted, and it has done much to prejudice station engineers against them. The rapid depreciation in capacity not having been understood, engineers have been surprised to find after some months' use that the capacity is only a low percentage of that specified, and this results in overworking, consequently more rapid deterioration.

Engineers and accumulator makers ought to state in their specifications what they respectively require and guarantee in capacity after stated periods of time; then the defect of installing batteries too small for their work would be obviated.

The maintenance of a battery is another point to which accumulator makers would have done well to give greater consideration. The yearly maintenance charges have been too high, yet even then there has been a loss to the battery people in many cases. And why? Because they have practically left the battery to take care of itself, instead of organising methodical and systematic inspections. Periodic examination would have saved many batteries from ruin. Thus where the makers have saved shillings in wages, travelling expenses, &c., they have lost pounds in having to renew parts of or whole batteries. The number of batteries now in use is sufficient to warrant their periodic inspection and maintenance being made a separate department. With

a reduction of the excessive maintenance charges the number to be attended to would increase, and this department should become a paying one; the manufacturers would benefit additionally by the greater confidence in accumulators that station engineers would have.

We now come to the second consideration, viz., ignorance of the care of accumulators.

One cannot go through many stations and see the number of batteries out of use, or hear of the great trouble they have given, without realising that ignorance of the management of a battery is very widespread.

A general idea seems to prevail that a battery should do a large amount of work and receive little or no attention; and so it is neglected until the capacity and voltage become so low that something must be done if it is to be of any service. The old maxim, "a stitch in time saves nine," is truer of nothing than a battery, and it will be found that if a battery is neglected the trouble afterwards will be very great.

Let us consider, then, a few points that should receive attention. One person should be recognised as accountable for the battery. If the responsibility is to be divided, it is advisable that each person should be answerable for a particular section, and in this manner each one feels his responsibility; whereas, if two or three persons are jointly responsible for the whole of the cells, none feels actually and personally so. In some cases there may be serious objections to this plan, but whenever possible it ought to be carried out.

A word with reference to the battery room. If the battery is recognised as an important part of the plant, why is it so often relegated to the place in the building which is considered unfit for anything else? Certainly, in new stations this point is receiving more consideration, but there are many valuable batteries in totally unsuitable places. The importance of space, light and ventilation cannot be too greatly insisted on. Can men be expected to work efficiently in cramped, ill-lighted, badly-ventilated battery rooms, when, even under the most favourable conditions, these rooms are unenviable places?

The writer's experience with a number of batteries has led him to the conclusion that much of the trouble with them is occasioned by primary neglect and ignorance of elementary principles. By primary neglect is meant the omission of systematic examination of the battery, while it is in good working order, not failure to try to bring it up to the mark when it is found to be low. The lack of knowledge of the elementary principles is very striking. A short article giving examples of this was published in the Review some time ago. It is better to have a labourer who does not understand anything of the theory, but who will attend regularly to his work, than a technical man who is incompetent, or neglects his duties. Probably the best arrangement would be to have a labourer to attend to the battery, with an assistant engineer who really understood it to be responsible for it, and for the man's carrying out of his duties.

It is usually the regulating cells that give the most trouble, and it may generally be traced to one of two causes—either undercharge or overcharge. An unsuitable regulator may be one fault; another, the neglect in cutting out cells as they become charged. A third and common fount of troubles is that when the cells are in parallel on the bus bar, a small amount of current is allowed to pass into the battery. This is thought to be a good plan; but a little consideration will show that in this manner, though a number of the regulators are always in circuit when the battery is discharging, they have received less charging current than has the main battery, with the result that when as a whole it is being charged, the main battery "comes up" first and must either be overcharged until the regulators are "up," or the regulators be left under-charged, with the too-well-known results.

A case of this character recently came under the writer's notice. The figures for a battery were taken for a number of days, and it was found that though the main battery had had more than the specified overcharge, a number of the regulating cells had received charge less than they had been discharged. From experience the writer has found that one of the simplest and surest methods of keeping a battery in order is to examine the cells for "gassing" towards the end of *every* charge. Should a cell not begin to gas for some time after the others, it should be *at once* examined for "shorts," and these removed; if this is done promptly, it will probably "come up" all right without special charging.

The charge in ampere-hours should always exceed the discharge, but only by 10 per cent. to 15 per cent., according to instructions. In addition a weekly milking charge given at a slow rate, till all the cells are gassing freely, will do much to keep the battery in good condition. A "hospital set," or a "milker," is also a valuable aid. The "hospital set" consists of a number of cells used for special purposes—often the meter-testing room—which are available for charging up any low cells in the battery. These hospital cells should be connected to a plug board, so that two, or any required number, can be plugged on to the milking leads, which are in turn, clamped on to the low cells. A "milker" is a small motor-generator, the motor side usually being driven off the 200—250 volts station lighting mains, and working (direct coupled) a small dynamo giving 100—150 amperes at 10—15 volts.

The usual small 2-volt lamp for examining the interior of the cells should always be at hand. Care should be taken not to allow the electrolyte to be lower than the tops of the plates, or the mud which falls to the bottom of the cells to accumulate till it reaches and thus short-circuits them. A case came under the writer's notice of a battery that gave considerable trouble, and it was only when several sets of plates had been removed that it was found to be due to the latter cause.

In different stations there are various methods of recording the work done by, and the state of, the battery. The records are usually taken weekly, and include the specific gravity and voltage of each cell; they are valuable if they are studied, and not left in the record book in the office drawer.

Weekly records should always be taken, and should comprise, besides the voltage of the whole battery and of each cell and specific gravities, the figures of all charges and discharges, with the watt-hour efficiency and ampere-hour efficiency over the week.

From these records the chief or his assistant can see at a glance what the battery is doing, and the condition of each cell. This weekly supervision, and the regular examination during every charge as previously mentioned, should suffice to keep the battery in good working order, with the maximum capacity and the minimum depreciation.

In these few notes the writer has tried to indicate what, from practical experience with central station batteries, he knows to be the general causes of trouble, and to point out what is, in his opinion, the best method of dealing with the battery. Station engineers should look on accumulators and accumulator makers as their friends, and the prejudice against a part of the station that is so conducive to economy should cease to exist.

## REVIEWS.

*The Encyclopædia Britannica.* Vols. I. and II. New series. London and Edinburgh: Adam & Chas. Black. 1902.

These are the twenty-fifth and sixth volumes of the completed work, and if we were to judge the whole of the additions from one volume, the additional volumes would be nearly as numerous as the original 25, for in one volume before us there is nothing whose initial letter is not A in the whole of the 808 pages. Among other articles of interest we find Accumulators, Acetylene, Aeronautics, Arbitration, Aluminium and Argon.

The information on accumulators occupies 10 pages, and is from the pen of Mr. Walter H. Hibbert, an acknowledged authority on accumulators. The article is simple and to the point. "Never discharge below 1·85 potential difference, or, on rapid discharge, 1·8 volts," "Never, if possible, leave cells discharged;" give a special full charge every month; make a periodic examination of every cell; keep any cell off discharge if it shows signs of weakness—these and other axioms will commend themselves to those who know, and

ought to be urged on cell attendants, for bad usage is the bane of the secondary battery; it has also suffered much from over-sanguine expectations formed of its powers, which are, after all, limited to a comparatively narrow range of action.

The subject of aeronautics is advanced to fairly modern date, and includes illustrations of Santos Dumont's flying balloon. There are also descriptions of the "Union" of Ader, which was of the arched form demonstrated by Lilienthal as correct. It was with this type that Lilienthal made over 2,000 glides through the air with safety before he was upset by a gust and killed.

Under the head of Acetylene, we learn that this gas is liquefied at 21·53 atmospheres when at 0° C. of temperature, and that at — 82° C. it becomes liquid at 1 atmosphere, the critical point being 37°, at which 68 atmospheres will liquefy it. Berthelot and Violle showed that if liquid acetylene were heated at one spot only by a platinum wire raised to a red heat, the whole mass decomposed and gave a pressure of 71,000 to 100,000 lbs. per square inch. This, of course, put a stop to the liquefaction of the gas, though shock appeared to have no effect in causing explosion. It appears that compression of the gas should not exceed 30 lbs. per sq. in. At — 90° C. the solid form is assumed.

The article on algebraic forms will doubtless form pleasant reading for the mathematicians. Beyond the articles named, there are few in the first volume that appeal particularly to electrical men, but the mass of general information in this one volume is so large, that the whole "Encyclopædia Britannica" may well be described as the essence of all human knowledge brought up to date.

In the second volume, which extends on to Chi, there are articles on boilers, by Mr. J. T. Milton; on brakes, by S. H. Banister; bridges, by W. C. Unwin; also on calorimetry, canals, cement, chemistry, all of which bring their respective subjects more or less up to date. The second volume sustains the merit of the first, and also its demerits in respect of woodcuts, of which much cannot be said, for they are decidedly poor. Still, engravings are not everything, and cannot spoil the value of the publication.

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*Coal Cutting by Machinery in the United Kingdom.* *Colliery Guardian* Series of Handbooks, No. 15. By Sydney F. Walker, A.M.I.C.E. London: *Colliery Guardian* Company, Limited.

This work is a reprint of articles from the columns of the *Colliery Guardian*, and is of considerable interest. Undoubtedly the best way to study any particular class of machinery is to obtain a work dealing fully and exclusively with that particular class, noting the failures and successes of the various types. This work fulfils that requirement to a large extent.

The author throughout is specially pleading for the general adoption of coal-cutting machinery, and fairly well proves a strong case for a much more extended use of power-driven machinery in place of hand work, if we are to believe all that is said and written about superior foreign competition. The same lethargy is said to have overcome the mining industry which we are familiar with in some other British businesses. The author fears Americans can within a short time compete with coal as successfully as they have done with corn, unless we adopt machinery to a much larger extent in coal-getting. To some extent his views are correct. In coal mining, as in other things, the British owners are loth to go in for new departures, and modern improvements are adopted very slowly. But there is a great difference between coal and corn. The harvest of corn can be raised every year; the coal is a limited quantity, and every decade our quantity of easily won cheap coal is diminishing at an accelerating rate, for nearly every modern advance, electric light, power, traction, and other advances call for more coal. The fuel for the "hay motor," as the working horse has been called, is replenished from the earth yearly, but the mechanical motor consumes a fuel which can never be replaced; hence perhaps this prospect of plenty of cheap coal from America is a blessing in disguise, for a time is approaching when our own available coal will be costly to win, even with the aid of machinery to the greatest extent. Coal is our raw material, upon which our great industries rest, and the question whether the prolongation of the home supply by a supplementary supply from America would, or would not, be an unmixed evil, is a question for consideration; the author seems to think that the competition in coal is to be resisted by all means, but does not demonstrate any good reason therefor, and there is the other view, namely, if the home supply is inadequate and therefore costly, the foreign coal might be as satisfying and welcome as foreign corn; we must have plenty of coal and corn, or perish.

Electric coal-cutters are treated but slightly. The difficulties with coal-cutting machinery are immense; large power is required in a strong rigid machine, working in confined spaces. The different advances made under most adverse and discouraging conditions by the many inventors are fully set out, and one quite agrees with the author that one of these conditions should be reversed, if machinery is to have a chance of success. Instead of the machine inventor, or maker (or crank), as some scoffers call him, seeking for work for his machine, the colliery owners should be seeking for machines to do the work, and should do all in reason to encourage their success.

This also applies all round in every other industry; the complaint is, that improvements have to be for years and years knocking at the manufacturers' door and begging for admission, while our competitors are eagerly snapping them up. However, on the whole, we don't think the colliery engineers so lethargic as many other engineering businesses; there is evidence of a considerable amount of wide-awake alertness among the colliery fraternity.

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*Deep Level Mines of the Rand and their Future Development.* By G. A. Denny. Crosby Lockwood & Son. 25s. net.

At a moment when all eyes are turned to the reopening of the mines of the Rand at the conclusion of the war, this book appears, filled with information, statistics and data which should enable those interested, or wishing to be interested, as shareholders in the newer developments, to form a good idea of the future possibilities. The position of the Witwatersrand gold mines on the outcrop of the celebrated reefs, as to working and possibilities, is so well known, and the life of some of them now growing so short, that attention is being forced to the next row of mines at a greater depth, say, 1,000 feet, known as deep level, and there is to be considered the possibility of the third row of mines at a depth of, say, 4,000 feet, and even possibly another row at 6,000 ft. below the surface. This book deals exhaustively with all the problems, mining, engineering and financial, to be met and dealt with, and those interested must be referred to the contents, which are not perhaps specially interesting to the general body of the electrical profession; but what is of great importance is the fact recognised by the author that the power supply, particularly for pumping at these depths, must be electrical. He gives an estimate for the pumping plant for a mine 4,000 ft. deep, coming to the respectable total of £107,200, a figure equal to the expenditure on many central stations of medium-sized towns.

An interesting estimate is given by the author as to the probable future output, and he calculates that by the end of 1906 the monthly output of the Rand will be 3½ million pounds, or £42,000,000 per annum.

To those who are working in the direction of the power application of electricity in mining, we can cordially recommend this work.

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**Barnstaple.**—A system of deferred payments for wiring has been adopted by the Town Council. A loan of £21,000 at 3½ per cent. has been taken up for electricity purposes.

## BUSINESS NOTES.

### Electrical Wares Exported.

| Week ending June 25th, 1901. | | Week ending June 24th, 1902. | |
|---|---|---|---|
| Adelaide | Value £220 | Adelaide | Value £68 |
| Alexandria | 7 | Alexandria | 22 |
| Amsterdam | 144 | Amsterdam | 62 |
| Beira | 74 | Bilbao | 131 |
| Bombay | 181 | Buenos Ayres | 1,614 |
| „ Teleg. mat. | 196 | „ Teleph. cable | 205 |
| Calcutta | 1,886 | Calcutta | 591 |
| Cape Town | 1,368 | „ Teleg. wire | 111 |
| „ Teleg. mat. | 48 | Cape Town | 188 |
| Chinde | 10 | „ Teleg. mat. | 975 |
| Christiania. Teleg. wire | 20 | Channel Islands | 181 |
| Colombo | 98 | Colombo | 201 |
| Durban | 466 | „ Teleg. mat. | 451 |
| „ Teleg. apparatus | 189 | Durban | 2,936 |
| Fremantle | 591 | Fremantle. Teleg. wire | 189 |
| Gibraltar | 12 | Gibraltar. Teleg. mat. | 15 |
| Halifax | 71 | Hong Kong | 334 |
| Malta | 86 | Melbourne | 405 |
| Mauritius. Teleg. mat. | 41 | New York | 500 |
| Melbourne | 168 | Perth | 80 |
| „ Teleg. cable | 1,023 | Port Elizabeth | 66 |
| North Atlantic. Teleg. cable | 1,000 | Shanghai | 270 |
| Ostend | 50 | Sydney | 2,185 |
| Penang | 72 | „ Teleg. wire | 160 |
| „ Teleg. mat. | 31 | Townsville. Teleph. cable | 528 |
| Perth | 105 | Wellington | 60 |
| Port Elizabeth | 18 | Yokohama | 488 |
| Port Said | 42 | | |
| Rio Janeiro | 89 | | |
| Shanghai | 196 | | |
| Singapore | 83 | | |
| Stockholm. Teleg. wire | 177 | | |
| Sydney | 25 | | |
| Valparaiso | 75 | | |
| Yokohama. Teleg. cable | 6,634 | | |
| Total | £14,737 | Total | £12,221 |

### Foreign Goods Transhipped.

| | | | |
|---|---|---|---|
| New York. Elec. motors. | Value £169 | Boulogne. Elec. cable | Value £400 |
| | | Brussels. Elec. goods | 80 |
| | | Total | £480 |

### Electrical Wares Exported.

| Week ending July 2nd, 1901. | | Week ending July 1st, 1902. | |
|---|---|---|---|
| Adelaide | Value £362 | Adelaide | Value £63 |
| Alexandria | 70 | „ Teleg. cable | 54 |
| Amsterdam | 110 | Alexandria. Teleg. mat. | 328 |
| Bandjermassin | 165 | Amsterdam | 37 |
| Bangkok | 162 | Boulogne | 140 |
| Bombay | 25 | Calcutta | 195 |
| Brisbane | 41 | Cape Town | 251 |
| Buenos Ayres. Teleg. mat. | 150 | Fremantle | 59 |
| Calcutta | 215 | Hamburg | 169 |
| „ Teleg. cable | 454 | Melbourne. Teleg. wire | 1,320 |
| „ Teleg. wire | 197 | Nagasaki | 312 |
| Cape Town | 6 | Shanghai. Teleg. apparatus | 9 |
| „ Teleg. instruments | 652 | Sydney | 545 |
| Colombo | 140 | | |
| Copenhagen | 2,281 | | |
| Durban | 341 | | |
| East London | 150 | | |
| „ Teleg. mat. | 534 | | |
| Fremantle | 20 | | |
| Flushing | 26 | | |
| Halifax | 44 | | |
| Hamburg | 45 | | |
| „ Teleg. mat. | 200 | | |
| Lisbon. Teleph. mat. | 202 | | |
| Madras | 268 | | |
| Melbourne. Teleg. wire | 1,375 | | |
| Perth | 104 | | |
| Port Elizabeth | 48 | | |
| Rotterdam. Teleg. wire | 70 | | |
| Shanghai | 41 | | |
| Singapore | 202 | | |
| „ Teleg. cable | 47,000 | | |
| Stockholm. Teleg. wire. | 99 | | |
| „ Teleph. cable | 18 | | |
| Sydney | 1,761 | | |
| „ Teleg. mat. | 80 | | |
| Vancouver | 200 | | |
| Total | £57,746 | Total | £3,483 |

### Foreign Goods Transhipped.

| | | | |
|---|---|---|---|
| Fremantle. Elec. mchnry. | Value £2,260 | Gothenburg. Elec. appar. | Value £40 |
| Perth. Elec. mat. | 486 | | |
| Total | £2,746 | | |

**Books Received.**—"Notes on the Construction and Working of Pumps," by E. C. R. Marks. Manchester: The Technical Publishing Company, Limited, and John Heywood, 1902. 3s. 6d. net.

"Die Telegraphie Ohne Draht," by A. Prasch. Vienna: A. Hartleben, 1902. K. 5.

"Science Abstracts," No. 54, June 25th, 1902. London: The Feilden Publishing Company, Limited. 2s.

"Journal of the Institution of Electrical Engineers," No. 157, June, 1902. London: E. & F. N. Spon, Limited. 5s.

"Information as to Mining in Rhodesia." London: The British South Africa Company, 1902.

"A Practical Treatise on Modern Gas and Oil Engines," by Fredk. Grover. Third edition. Manchester: The Technical Publishing Company and John Heywood. 5s. net.

"Fire Tests with Floors." No. 71. London: The British Fire Prevention Committee, 1902. 2s. 6d.

**Catalogues, Lists, &c.**—The B.T.H. Company has issued new priced lists of its B.T.H.-Edison incandescent lamps.

The Davis Electric Lamp Company, of 16 to 24, Morwell Street, W.C., have issued an illustrated catalogue of their incandescent electric lamps of various shapes and sizes, and for high and low voltage.

We have received from the G.E. Company (1900), Limited, a leaflet describing their new system of intercommunication telephones (the "Combat" common battery system), which has been specially designed to bring these useful instruments within the reach of those who have hitherto considered such a system an expensive luxury, and which, while moderate in price, is of best manufacture. These telephones are entirely British made at their Manchester works, and the system has been patented by the company. Besides the above-mentioned advantages, the working of the telephones is claimed to be exceedingly simple, for the selection of a line and the operation of ringing is effected by one and the same movement, namely, by the insertion of a loose plug. From the same company we have also received a list of their "Omega" high insulation flexible electric light cords.

**Liquidation.**—A winding-up order having been made against the Meyra Electric Company, Limited, on the petition of Mr. Bridgewater, a judgment creditor for £600, the statutory meetings of the creditors and shareholders were held on Tuesday last at the Board of Trade offices, Carey Street, Lincoln's Inn, W.C. Mr. Winearls, Assistant-Receiver, presided, and Mr. S. Myers, Mr. Moore, and Mr. Evans represented various interests. The chairman reported that no statement of affairs had yet been lodged, but the Official Receiver was informed that the unsecured debts amounted to about £1,650, and the only assets in the estate were book debts of the face value of £600, and expected to yield £400. The company was registered in September, 1900, with a capital of £10,000, to acquire and work an invention for improvements in galvanic batteries, and to acquire certain letters patent which were to be granted to Mr. Paul Meyer. The purchase agreement provided for the acquisition from Mr. Meyer of all his rights in the invention and letters patent; also of the trade mark "Meyra," and the secret process to drive the batteries. The consideration was £14,993, to be satisfied as to £9,993 in fully paid shares, and £5,000 in 5 per cent. debenture bonds, which charged all the assets of the company. It would thus be seen that, with the exception of the £7 signatories' shares, the whole of the capital was allotted to the vendor, who was appointed, in addition, to the post of managing director for five years, at a salary of £250 per annum. Mr. Meyer entered into an agreement with Mr. Cobbett, the promoter, to hand over to the latter, or his nominees, £4,993 shares in consideration of that gentleman registering the company and indemnifying Mr. Meyer against all charges and expenses relating to the registration, and for other services. In November, 1900, Mr. Meyer was granted six months' leave of absence, and in the following June a further absence of 12 months was allowed him, Mr. Bridgewater filling the vacant post. At the date of the formation of the company, Mr. Meyer was carrying on business as a dry battery maker at 75, Newman Street, and on the registration of the company this business was transferred to the company's premises at York Road, King's Cross. The stock was taken at a valuation, and the company undertook to satisfy the debts of the business. On November 24th, 1900, an extraordinary general meeting was called to consider the question of working capital, the idea being to issue £2,500 debentures to rank *pari passu* with the £5,000 bonds which had been previously issued to the vendor. No action was taken at that meeting, and Mr. Bridgewater alleged that Mr. Cobbett was to provide the necessary working capital. The latter gentleman, however, disputed that assertion, although, as a matter of fact, he made advances to the company from time to time. Pending a settlement of that question Mr. Meyer refused to transfer the patents or to disclose the secret process, and consequently the purchase by the company had never been effected. The failure of the company was ascribed to the absence of working capital. A resolution was passed for the liquidation to remain in the hands of the Official Receiver.

**E.L.B. System.**—Whilst the English company was busily engaged with Coronation requirements on this side of the water, the French company was attending to the equipment of several of the visitors to our Naval Review, as, for instance, the French cruiser *Montcalm* and Baron Rothschild's splendid yacht. The French company is now busily occupied with preparations for the Government and Municipal celebrations of July 14th, having only recently completed the arrangements of the great fête at Neuilly.

We are informed that, in most cases, instructions have been received by the E.L.B. Company to keep the Coronation illuminations in position with the hope that they may be utilised on the recovery of the King. Among the large public buildings equipped on the E.L.B. system where this has been the case, is notably the Stock Exchange; and the lighting on the company's system at Westminster Hall remains untouched until further notice.

**For Sale.**—The Coventry E.L. Committee is offering for sale a 100-B.H.P. Fowler horizontal compound engine. See our advertisement pages to-day.

Messrs. P. Huddleston & Co. will, on August 14th, sell various machinery and plant at the Ballsbridge and Clontarf depôt of the Dublin United Tramways Company, comprising W.T. boilers, engines, generators, motors, economisers, &c. Some particulars are given in our advertisement pages.

**Spain.**—A company has just been formed in Madrid to establish works for the manufacture of electric lamps in accordance with the patents of Signor Bernardo Cabanas, a military engineer. The works will have at first a capacity of 500 lamps per day.

**Coal Consumption of Boilers.**—The question "What is our coal consumption?" is repeatedly being asked in every electric lighting station in the world, except those in which energy is generated by methods other than the consumption of that form of fuel. From the Colonies, from America, Germany, France, and other countries the same question is always rising, and the illustration shown below gives a good idea of how this question can be satisfactorily answered. Each boiler with its double flue and automatic stoker is supplied with an automatic scale fixed beneath the coal bunker, and just as fast as the mechanical stoker requires the coal, so each scale automatically registers the quantity passing through it. To automatically weigh material is by no means a new idea; in fact, upwards of 1,500 of the "Avery" scales alone are working, but to weigh coal under conditions such as these is a new departure, and is the result of many years' experience. The accuracy is within ½ lb. in 1 cwt., and that is quite near enough for the requirements of a power station. The particular advantage of the scales perhaps lies in the fact that the consumption of coal on each shift is entered in the log, and thus comparisons in the working of a very important character can be made. Most electric stations with overhead coal bunkers can be fitted with these machines. It is interesting to know that in America one large station is to be equipped with 48 of these scales, and a still larger station with 90 scales, for in the States they are just as much alive to the necessity of weighing their coal as we are in this country, where a large number of stations are being equipped. Full particulars can be obtained from the makers, W. & T. Avery, Limited, Soho Foundry, Birmingham.

Coal Consumption of Boilers.

**Lightning Disaster.**—It is reported from Madrid that a disaster has occurred at Allariz, in the province of Orense. During a thunderstorm lightning destroyed a church, while mass was being celebrated. Twenty-five persons were killed and 30 injured.

**Outings.**—The employés of the London Electrical Fittings Company, Limited, had their annual outing on Saturday last, spending a very enjoyable day at Margate. We understand that this firm is so full of orders that it has had to add to its premises at Roberts Works, Hampstead Road.

Messrs. Laurence, Scott & Co., Norwich, gave their employés, to the number of 100, their annual outing on Saturday at Southwold.

**Russia.**—It is proposed to instal in the Caucasians a furnace for the treatment by electricity of manganese ore, which is very abundant in the district.

**Salford Electricity Works.**—We have received the following letter from Mr. W. Fox, of Patricroft:—"Having noticed your report and description of the various mechanical appliances used at the Salford Corporation electricity works, I wish to call your attention to the oil-filtering apparatus, &c., fixed by me. These filters are capable of dealing with the crank chamber oil in a very quick and inexpensive manner, as will be seen by the following description:—Each engine, which contains about 200 gallons of oil in the crank chamber, is connected by a 2-in. main drain pipe to a 500-gallon settling tank below the floor line. On opening the outlet valve the oil flows into the settling tank; the crank chamber is then flushed out with a fire hose, and a three-way tap fixed on the settling tank is shut off from the tank, and opened to the main sewer. Another 500-gallon tank is placed in the upper part of the station, with three filters on top of it; this tank is kept nearly full of filtered oil, and has a partitioned wing for new oil. When the engine is emptied and washed out, the 1¼-in. main pipe from the filtered-oil tank is opened, and the oil rapidly fills the engine bed. The process of emptying out the dirty oil, washing out the bed, and filling up with filtered oil, can be done by one man in about two hours. The oil in the settling tank is connected to the filters by an electrically-driven oil pump, which draws the oil from the settling tank through a floating suction valve, thus only taking the best of the oil, which can be seen through a water gauge, and delivering it into three large filters through ⅝-in. bore taps, one over each filter, which has a filtering surface of about 10 sq. ft. These filters are all connected to each other, so that in case one chokes up, it overflows into another one, thus throwing double work on the latter, and *vice versâ*, until all three become choked, when the oil overflows into the float box, and automatically stops the pump."

**Shoreditch Electricity Works.**—In our recent description of the above-named works, we omitted to mention that the Ayrton & Mather voltmeters were made by Messrs. Nalder Bros. and Thompson, Limited.

**Small Lighting Sets.**—Messrs. Reavell & Co., Ltd., have issued a circular of the small lighting sets which they are introducing for a number of purposes, such as yachts, tugs, laundries, small workshops, quarries, &c. These sets are made in six sizes, and have an output varying from 13 to 150 8-c.p. lamps, or their equivalent, and should be invaluable to all small users who use steam and require light, and have not hitherto found a sufficiently inexpensive plant. The whole set is self-contained and of simple design, thus rendering it possible for anyone of ordinary skill to erect and have it running in a few hours. The sets are extremely light, take up very little room and are inexpensive.

**Traction Telephones.**—In our recent article on the Cardiff electric tramways reference was made to the complete system of telephones provided on the various routes. We regret that due credit was not given to the General Electric Company (1900), Limited, for the manufacture of the apparatus on their special system. The same system, we understand, has been installed on upwards of 50 electric tramways, including Newcastle, Salford, and Oldham among the most recent.

**Trade Announcements.**—The Universal Electric Supply Company have opened a head office and warehouse at 60, Brook Street, C.-on-M., Manchester, to which address all communications should be sent in future.

The offices of the Baker Street and Waterloo Railway have been removed to Hamilton House, Victoria Embankment, E.C.

From July 1st the Manchester office of Dick, Kerr & Co., Limited, will be removed from Prudential Buildings, 78, King Street, to the Northern Assurance Buildings, Albert Square, Manchester.

The Paris house of Ludwig Moser & Fils will hold an exhibition in London at the Manchester Hotel, Aldersgate Street, E.C., from July 1st to 11th. The exhibition will include a rich assortment of all products of their Karlsbad glass works. Mr. G. Moser will attend.

It is intended that the name British Insulated Wire Company, Limited, shall shortly be altered so as to embrace the characteristics of both the B.I.W. and Telegraph Manufacturing Companies.

**Vicars' Stokers.**—We understand that Messrs. T. & T. Vicars have secured through their agent, Mr. R. B. Howatson, of Glasgow, an order from the Glasgow Parish Council, for their Stobhill Hospital, for five pairs of their mechanical stokers suitable for Lancashire boilers. The Glasgow Parish Council will now have some 30 of these stokers at work.

## ELECTRIC LIGHT AND POWER NOTES.

**Bath.**—With respect to the application of the T.C. to borrow the sum of £25,000 for new works, the L.G.B. sanctioned the borrowing of £11,196 required to defray excess expenditure on works in respect of which loans had been sanctioned by the Board, and the cost of other works already executed. With regard to the remainder of the application, the Board deferred decision until they had been furnished with further particulars. The Committee recommended a special proviso in the contract with Messrs. Dick, Kerr & Co., entitling that firm to a payment of £30 a day for 13 days if they delivered the work by September 7th.

**Birkenhead.**—The Electricity Committee has revised the scale of charges for power and heating, the new scale being, for supply within the borough, 2½d. per unit for the first 500 units; 2d. per unit for every additional unit up to 1,500; and 1½d. for every unit beyond.

**Bolton.**—Sanction to raise a loan of £124,030 for electric lighting purposes has been received by the T.C. from the L.G.B.

The salary of Mr. W. J. Baker, assistant fittings superintendent in the electric light works, has been increased to £120 per year.

**Bridgend (Glam.).**—The U.D.C. has decided to charge 5d. per unit for the supply of electricity for lighting.

**Bury.**—In his annual report, Mr. S. J. Watson, manager of the electricity works, states that the number of consumers connected during the past financial year was 51, with 6,108 8-C.P. lamps, making a total to March 31st, 1902, of 305 consumers and 24,668 lamps. The units sold during the past year were 323,337, as compared with 261,247 for 1901. The output had increased by 62,090 units, or 23 per cent. The capacity of the works remained at 14,600 8-C.P. lamps alight at once. This would allow about 30,000 8-C.P. lamps to be connected to the mains. Thirty-four arc lamps are now in use in the principal streets. Seventeen incandescent electric fittings, each consisting of two 8-C.P. lamps, had been fixed in existing gas lanterns. The total motors now on hire equal 117½ H.P. For motor and heating purposes 59,773 units had been supplied, compared with 24,471 units for the previous year. Number and horse-power of motors to March, 1902, 48 motors, equal to 187 H.P.; generating costs, £2,664, equal to 1·97d. per unit; interest and sinking fund, £2,609; total cost, £5,273, equal to 3·91d. per unit; loss, £159; revenue, £5,114, equal to 3·79d. per unit. The gross profit is £2,450, compared with £1,650 for the previous year. Interest and sinking fund charges had increased from £2,307 to £2,609. The result was a loss of £158 on the year's working, compared with a loss of £657 last year. The total outlay is now £51,126. Additional borrowing powers will shortly be required to carry out extensions of the lighting cables, and for motor hiring purposes.

**Chichester.**—The City Council on June 20th decided, subject to a satisfactory agreement, to transfer its electric lighting order to the Sussex Electrical Power Company, which has just laid down plant at Lewes. The Council's terms are that the company shall repay the Corporation the £300 incurred in obtaining the order; that the company shall forthwith proceed to carry out electricity works in the city; that the Council have option of purchase by valuation as a going concern at the end of 14 or 21 or subsequent years; that 3d. per unit be charged for public lighting, and 2½d. per unit for private consumers over and above a stipulated quantity each quarter.

**Ceylon.**—*Indian Engineering* recently stated that a special electrical engineer was to be engaged from England by the Ceylon Government and the Colombo municipality combined.

**Coventry.**—The T.C. has resolved to sell one of the old generating sets, and to put a set of 1,000 H.P. in its place.

**Dublin.**—At the meeting of the Lighting Committee recently, Mr. Hammond's report of the progress of the electric lighting works showed that during the past fortnight nearly 9,000 yards of cable had been laid, bringing the total length of cable in connection with the new electric lighting system laid up to Saturday last to 128,000 yards. At the Pigeon House the walls are now within a few feet of the roof level, and the chimney shaft is up to a height of 66 ft. The building work on seven of the sub-stations throughout the city has been completed, and satisfactory progress is being made with the manufacture and delivery of the generating plant.

**Dewsbury.**—A L.G.B. inquiry is to be held on July 9th into an application of the Corporation for sanction to borrow £10,000 for the extension of the electricity works, necessitated by the supply of energy to the B.E.T. Company.

**Ealing.**—The report of the electricity department for the year ending March 31st, shows that the total number of consumers was then 991, with 45,448 8-C.P. lamps—an increase of 24 per cent. The average price per unit obtained was 5·61d., and the total revenue was £14,741. The output was 705,786 units, an increase of 17 per cent. The gross profit was £6,558, and the net profit, after paying interest and sinking fund charges, was £420 10s. 11d.

The T.C. has resolved to apply for leave to borrow £10,000 for electric lighting purposes.

**Finchley.**—A L.G.B. inquiry has been held in respect of the application of the U.D.C. for leave to borrow £35,000 for the first portion of the electric lighting scheme. Evidence was given in opposition to the scheme on behalf of the ratepayers, the Finchley Electric Lighting Company, Limited, and the North Metropolitan E.P.D. Company, the last offering to supply electricity at 3¾d. per unit, and to give the Council power to purchase in 14 years or less.

**Halifax.**—The Tramways and Electricity Committee has decided to complete the alteration of the supply of electricity from alternating to direct current at an estimated cost of £2,712.

**India.**—An Indian exchange says that, in addition to the sanctioned estimate of Rs. 50,000 for lighting the Government Press at Madras with electricity, further estimates for lighting St. George's Cathedral, the General Hospital, and Government House, Ootacamund, with electricity, amounting to about 1½ lakhs, have been submitted for sanction.

**Isle of Wight.**—The I. of W. Electric Light and Power Company has approached the East Cowes U.D.C. on the question of public lighting, and suggests a five years' agreement. The matter is being considered by a committee.

**Italy.**—Messrs. Brisschi, Tinzi & Co., of Milan, have applied for a concession for a hydro-electric station, of 1,625 H.P., on the Isorno torrent, which is situated in the territory of Montecretese, and which has a head of water of 304·70 metres. The cost of the undertaking is estimated at about 110,000 lire.

**Kingston-on-Thames.**—The following questions are to be put to an expert whom the President of the Institution of E.E. is desired to nominate:—(*a*) Regarding the advisability of increasing the price of energy from 6d. and 4d. to 8d. and 3d.; (*b*) as to the policy of extending arc lighting in the streets, and the relative advantages of arc and incandescent lamps; (*c*) as to the correct principle of allocating the cost of street lighting; (*d*) as to the provision of additional plant as recommended by the borough electrical engineer; (*e*) as to a modification of the existing high pressure alternating system; (*f*) as to a possible reduction in the cost of production.

**Llanberis.**—The Gwyrfai D.C. has received a letter from Messrs. Carter, Vincent & Co., on behalf of Mr. Assheton Smith, begging the Council to support an application which Mr. Assheton Smith intends making for a provisional order to provide electric works for the parishes of Llanddeiniolen, Llanfairisgaer, and a portion of Llanberis, with a view to supplying the districts lying between Port Dinorwic and Llanberis with electric power. The intention is primarily to supply the great quarries of Dinorwic, of which Mr. Assheton Smith is the owner, with electric power; but it is intended also to enable the quarry villages named to benefit by the proposed scheme. After some discussion the Council resolved to support the application.

**London.**—L.C.C.—The Finance Committee has considered and approved an application from the Islington Borough Council for sanction to the borrowing of £8,630 for the extension of electric lighting in the borough.

The Highways Committee of the L.C.C. states that the Lewisham and District Electric Supply Company intends, in conjunction with the Blackheath and Greenwich District Electric Light Company, to apply in the next session of Parliament for powers which would practically amount to an amalgamation of the undertakings of the two companies, so that the mains laid by the first-named company will be supplied with energy from a generating station belonging to the latter company.

Hackney.—The M.B.C. has been in negotiation with Messrs. Stapley & Smith as to the supply of electricity for power and lighting for their new factory in Sylvester Road. It was decided to offer the firm the following terms:—For lighting, 4d. per unit, for at least 30,000 units per annum; for heating and power, 1½d. per unit, upon a consumption of not less than 210,000 units per annum for the first year, and 250,000 units per annum for the second and subsequent years. Should the minimum not be reached in any one year, the charge for that year to be that in force for ordinary consumers of the Council for power and heating purposes.

Stepney.—The accounts of the first 15 months' working of the Stepney electric light undertaking show that up to the end of the period under review the capital invested in the works was £109,000. On the 15 months' working there was a loss of £2,743, while a balance from the next year's working of £2,034 is available towards the extinction of this loss. The consumption of electricity is growing at the rate of 400,000 units per annum.

Woolwich.—The M.B.C. has resolved that application be made to the L.C.C. for sanction to the loan of £101,000, required for the purchase of the Woolwich District Electric Lighting Company's undertaking.

**Malaga.**—We understand that the Malaga electricity works are about to lay down a complete installation of direct current plant in addition to their high tension system, which will in future serve only for the outskirts of the town, the cables to be of English make, but the engines and dynamos to be American. We understand that the orders are not yet given out, and we hope that English works will at least have an opportunity to tender.

**Medomsley.**—The Parish Council has received a letter from the Consett Iron Company, Limited, with reference to the Council's application for electric power for lighting about 30 lamps in the neighbourhood of Medomsley, intimating that they are prepared to enter into an agreement for this purpose similar to that now existing between the Council and the company.

**Northfleet.**—By 10 votes to 1 the U.C. has decided to obtain offers for the purchase of its electric lighting order, as the Council has no intention of putting it into force.

**Pontypridd.**—The Council has resolved that Mr. Wilson, electrical engineer, be instructed to proceed at once with the small electric generating plant, which the Council has resolved to erect in connection with the dust destructor.

**Sheffield.**—The electric light enterprise has done well since it came into the hands of the Corporation. There were 688 customers in 1898; in March last year the number had risen to 1,434, and the number of lamps installed was 130,892. The orders received during the last year represented an addition to the supply equivalent to over 22,000 8-c.p. lamps. Last year's accounts show that after paying all charges, a sum of £5,604 1s. 11½d. remained, making, with a previous surplus of £6,294 6s. 5½d., a total available of £11,898 8s. 5d. The income from all sources during the year was £23,831 0s. 5½d., and the expenditure £13,585 14s. 10d., leaving a gross profit of £26,245 5s. 7½d., out of which £20,641 3s. 8d. had to be paid in interest and sinking fund. A great deal of new machinery has been installed during the last 12 months, for power as well as lighting purposes. This branch of the business is to be greatly developed by the erection of a new power station at Neepsend. The capital expenditure of the concern up to the present amounts to £538,501 17s. 7d.

**Shipley.**—On 25th ult., shortly before half-past nine, a loud report was heard in the Market Place, and the heavy cover of a connection box over the electric lighting cables was displaced. Two young women were passing over the spot where the disturbance took place, and they both received injuries of a more or less serious character.

**Spain.**—The Spanish Ministry of Agriculture has lately published a report on the electric lighting undertakings in Spain, from which it is learnt that at the beginning of the current year there were 359 central stations in the country, of which 648 were supplying current for public, and 211 for private lighting. Gerona heads the list of provinces with 59 plants, followed by Vizcaya with 54, and Navarra with 47. The oldest central station is that at Santa Catalina (Baleares), which was established in 1878. It was not, however, until 1889 that the great development of electric lighting in Spain took place. For public lighting, 87,112 incandescent, and 1,470 arc lamps are in use in the country, while for private lighting there are 1,237,836 incandescent, and 2,819 arc lamps employed. Madrid naturally heads the list with the largest number of lamps, Barcelona coming next.

**Stamford.**—The second engine set was switched on at the Stamford electricity works of the Urban Electric Supply Co., Ltd., on Saturday last, by Mrs. Milns, the wife of the resident engineer. Although the works only commenced supply three months ago, applications for nearly 6,000 lamps have been received.

**Stretford.**—At a meeting of the U.D.C. on Tuesday evening, it was decided to accept tenders for steam-raising plant, £3,095; steam generators, condensing plant, &c., £5,619; and service mains, £9,682. A member stated that now the official sanction had been given for the borrowing of capital, the Council would proceed with the work of construction. He hoped that the township of Stretford would not have to wait a longer period of time than other districts surrounding Manchester for the provision of electric traction.

The L.G.B. has sanctioned the borrowing of the sum of £54,000 by the Council for electricity works. The generating station will be commenced immediately.

**Sudbury.**—The L.G.B. has refused to sanction the T.C.'s application for a loan of £12,000 for electric lighting, the margin of borrowing powers available being insufficient.

**Swansea.**—The Swansea Gas Company have resolved, since the Corporation has gone in for electrically lighting part of the town, to henceforth place the street lighting on the same basis as private lighting.

**Taunton.**—The extensions of the electricity works, which are carried on by the Corporation, were inaugurated on 23rd inst. The additions consist of a 500-h.p. Babcock & Wilcox boiler, condensers, a 250-kw. alternator, and a motor-generator. In addition to these extensions to the lighting plant, there have also been laid down one new engine and two 125-kw. generators, thus bringing the capacity of the station to 1,600 h.p. Additions have also been made to the switchboard, and new offices have been built. The total cost is £18,000. The consulting engineer was Mr. E. Manville, of Messrs. Kincaid, Waller & Manville, and the contractors were Messrs. Babcock & Wilcox for the boilers and steam pipes, and the British Thomson-Houston Company for the engines and dynamos. The engineers and contractors entertained the members of the Corporation and others to a banquet.

**Tien Tsin.**—A company has just been constituted at Brussels under the title of the International Lighting and Tramways Company (Tien-Tsin), for the purpose of constructing a system of electric tramways and supplying electric light in the town of Tien Tsin, as well as undertaking various other electrical projects.

**Truro.**—The T.C. has received an offer for the installation of electric light in the city from Messrs. Crompton & Co., Ltd., with the option of the Council purchasing at a later period.

**Turkey.**—An electric power plant is being put down at the Mandjilik lignite mines of the Société des Mines de Balia-Karaidin.

**Waterford.**—The Corporation has decided to abandon the electric lighting scheme, the estimate for which was £38,000.

**West Bromwich.**—The first annual report of the Corporation's electrical undertaking shows that up to March 31st this year there were 62,894 units supplied to consumers. The maximum load on the station occurred on December 20th, 1901, and amounted to 122 kw., equal to 83 per cent. of the total number of lamps. The total cost per unit sold in the 10 months' working was 4·48d. The total length of mains laid to date was:—Feeder, nearly 6 miles; distributor, 4¼ miles; pilot, 2¾ miles. The whole of this cable, except the pilot, had stood a pressure test since being laid of 2,000 volts between conductors for one hour. This voltage is eight times the working pressure of the cable. The total number of consumers wired by the department was 50, representing 3,208 8-c.p. lamps, or 66 per cent. of the total number of lamps connected, and an outlay of £1 650. On the 10 months' working there was a deficiency of £1,403.

**Worksop.**—The price of electricity for motive power has been reduced by the U.D.C. from 2d. to 1½d. per unit.

**Wrexham.**—The T.C. has applied for sanction to borrow £11,000 for machinery, &c., in connection with the extension of the electricity supply department. The Corporation has also consented to the request of the Electric Tramways Ltd., to the B.T. for extending the time for the completion of the tramways for six months after August 1st, 1902.

## ELECTRIC TRACTION NOTES.

**Manchester.**—A significant incident occurred last week at a meeting of one of the local urban district councils near Manchester. A letter had been sent by a committee in reference to certain improvements which they thought desirable at the suburban station, but the reply received from the local railway manager is that, until it is ascertained to what extent the new electric trams will affect the passenger traffic, he cannot accede to the application. Meantime, the number of passengers carried locally on the electric trams continues to increase by "leaps and bounds."

In consequence of the favourable bulletins issued in regard to the King's health, the illuminations of the Town Hall and other municipal buildings in Manchester took place on Friday and Saturday evenings. A novelty, which attracted considerable attention, was an illuminated electric tramcar, which travelled over the principal lines of the Manchester system. Indeed, the large part played by electricity in the illuminations in both Manchester and Salford was noteworthy.

(Continued on page 25.)

## NEW EQUIPMENT OF THE LIVERPOOL OVERHEAD RAILWAY.

One of the most important and essential advantages of electric traction on railways lies in the increased acceleration rendered possible thereby. A notable advance has recently been effected on the Liverpool Overhead Railway by means of a new type of equipment, supplied by Messrs. Dick, Kerr and Co., Limited. It will be remembered that the Liverpool Overhead Railway was the first elevated line in the world operated by electricity, and was originally equipped some 10

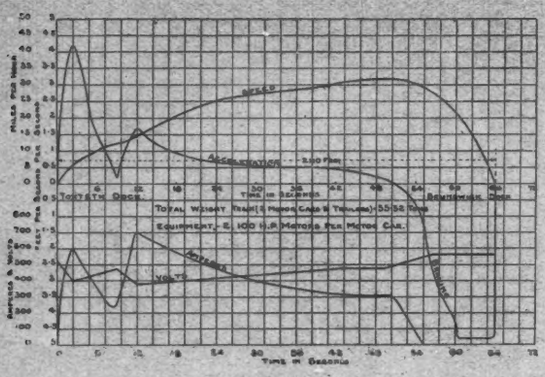


Fig. 1.

years ago. The total length of the line is a little over 6½ miles, with double track and a third rail feed, and rail return, operated by direct current at 500 volts. The trains are made up of two or three carriages, the larger trains weighing about 55 tons. With the old equipment the entire distance was run in 32 minutes, including 16 stops, or practically at a scheduled speed of 12½ miles per hour. This requires a minimum of 14 trains running at 5-minute intervals to cope with the traffic.

Some 12 months ago, however, it was decided to experiment with a new equipment, in order to ascertain what acceleration could be obtained, and Messrs. Dick, Kerr and Co., Limited, entered into a guarantee to run the whole distance, including 16 stops of 12 seconds, in 20·9 minutes; in other words, to improve the scheduled speed from 12½ to nearly 19 miles per hour. The weight of the train, including 154 passengers, was 55 tons. A most careful series of elaborate tests and trial runs was made by Mr. Cottrell, the engineer-in-chief of the Liverpool Railway, assisted by Mr.

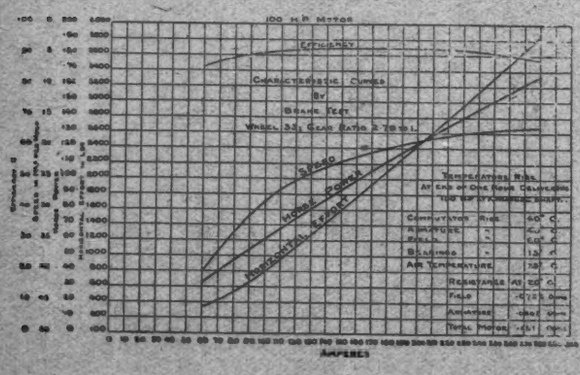


Fig. 2.

Mallock, and it was clearly demonstrated that the new train would make the journey easily under 20½ minutes. The acceleration curves obtained from these trials are shown in fig. 1. From these it will be seen that the acceleration reached 4·2 ft. per second per second, or nearly 3 miles per hour per second, the average acceleration being well over 1 mile per hour per second, thus enabling the train to cover the 2,110 ft. between the stations in little over 1 minute, including starting and stopping. This rapid acceleration is possible owing to the excellent commutation of the motors, which do not spark even when carrying 300 or 400 amperes; that is, three or four times their normal current. During the acceleration of the train in the series position of the controller, each motor is carrying a current of 300 amperes, as shown by the curve. The curves also show the perfect action of the brakes during the retardation of the train. The negative acceleration reached 4·75 ft. per second per second, which is probably near the practical limit in actual service. The diagrams of current and pressure at the motors are recorded, and are of interest in determining the power consumption at different parts of the run. Fig. 3 shows one of the new trains complete.

The frequent stopping of trains running at high schedule speed will consume from 120 to 150 watt-hours per ton-mile. If, however, the stops are far apart, the watt-hours required are from 90 to 100 per ton-mile. In the experiments recorded the watt-hours consumed were 137 per ton-mile, or about 6·35 kw.-hours per train-mile run. The results of the new accelerated service are shown in the following table. In consequence of the successful issue of these tests, the Liverpool Overhead Railway Company have instructed Messrs. Dick, Kerr & Co. to re-equip the whole of the rolling stock.

Results on the Liverpool Overhead Railway.

| | Old system. | Accelerated service. |
|---|---|---|
| Mean speed ... ... | 12½ miles (20 km.) | 19½ miles (31 km.) |
| Number of stops ... | 16 | 16 |
| Mean time at stations ... | 11 seconds | 11 seconds |
| Mean distance between stations ... ... | 729 yards (666 m.) | 729 yards |
| Watt-hours per ton-mile | 110 | 137 |
| Acceleration ... ... | 1·6 ft. (0·44 m.) per sec.² | 3 ft. (0·91 m.) per sec.² |
| Retardation ... ... | 3 ft. (0·91 m.) per sec.² | 4·8 ft. (1·26 m.) per sec.² |

Each of the new trains is to be fitted with four 100-h.p. railway motors, designed by Mr. S. H. Short, and built at the works of the English Electric Manufacturing Company, Preston.

The performance of these motors is shown in the efficiency curves, fig. 2, these having been made from actual measurements taken from one of the motors during the experimental run. The efficiency is unusually high, being practically 93 per cent. at the full load of 75 kw. Their weight is 4,200 lbs., or only 42 lbs. per h.p., which is a point of considerable importance in keeping down the dead-weight of the train.

The new motors are completely enclosed in a cast-steel shell, forming a fire and waterproof casing; this shell also serves to form the magnetic circuit of the fields and to support the armature and axle bearings. The only opening in the motor casing is over the commutator and brushes; this is, however, securely closed by a hinged lid fitted with fastenings, as shown in the photograph, fig. 5.

The motor frame is divided on the horizontal plane, the upper half being removable, leaving the lower half supported on the car axles and the nose suspension. In this way the armature and fields can be easily uncovered for inspection and repair, without entirely dismantling the motor. This method of opening the motor is just the reverse of the tram-car motor, where the lower half of the frame is let down into a pit for inspection of the interior; this would not be practicable with motors of such great size.

The interior of the motor frame is provided with four laminated steel pole-pieces, each with its own field spool, held in place by large bolts passing through the outer shell. The field spools are made of copper ribbon, about 2 in. wide, wound with asbestos and mica strip between the layers, and insulated outside with mica and asbestos combination boxes, held in position by means of heavy braided tape. The complete coils are treated with a waterproofing insulating compound and thoroughly baked. The same number of turns of copper ribbon is put on each pole, so that a perfectly symmetrical field is produced, in which the armature revolves.

The armature is ironclad, the copper bars with which it is wound being let into deep slots (fig. 4). Each coil in the arma-

ture is made with only one turn, and without joints, except at the commutator. The insulation of these coils is also composed largely of mica and asbestos, treated with a special insulating varnish, taped and baked. The coils are all alike and interchangeable, so that injured ones may be replaced with ease. Ample ventilation is provided for the interior of the armature core, and air ducts leading to the surface aid in keeping up a good circulation. The high-grade steel from which these cores are made ensures low hysteresis losses, and the thorough insulation of the laminæ from one other prevents the formation of eddy currents.

The commutator is very large, and has many bars, rendering the commutation perfect, even with double the normal load on the motor. The brushes are in two sets at the top of the commutator, with two brushes in each set. No sliding contacts are permitted to carry current, each brush being fitted with a brass clamp which moves with it, and a flexible braided ribbon of copper, connecting it directly with the brush-holder supports and main cables from the controllers.

The efficiency of the motor is well over 90 per cent., as shown by the characteristic curves of the machine. The temperature rise, after one hour's run at full load, is far below the standard of 75° C., being as follows :—

| | |
|---|---|
| Commutator ... ... ... | 55° C. |
| Armature ... ... ... ... | 39° C. |
| Fields ... ... ... ... | 57° C. |
| Pinion bearing ... ... ... | 14° C. |
| Commutator bearing ... ... | 9° C. |

The bearings are all made of the best bronze and provided with both oil and grease lubrication. Special provision is made to catch all the oil from the ends of the bearings and to return it to the wells, so that it will not drop on the permanent way. The gears are of cast-steel, with the teeth cut out of the solid casting. The pinion is of hammered machine steel. The gear housing is of malleable iron, made oil tight.

The complete equipment weighs as follows :—

| | |
|---|---|
| Motor ... ... ... | 3,945 lbs. |
| Gear ... ... ... ... | 260 „ |
| Housing ... ... ... | 140 „ |
| Links ... ... ... ... | 4 „ |
| Key ... ... ... ... | 2 „ |
| Total... ... | 4,387 lbs. |

or including gears, gear housing, &c., complete, only 43·8 lbs. per horse-power.

The motors are journalled at one end to the driving axle, and spring-supported on the bogey frame at the other end. This method of suspension relieves the permanent way of severe shocks at the rail joints and cross-overs. The motors are carried on the two end cars of the train. The controlling mechanism is in many respects similar to the series-parallel method of control adopted by Messrs. Dick, Kerr & Co., Limited, and is fitted with a new blow-out device which renders it perfectly proof against fire.

Fig. 3.—New Train on Liverpool Overhead Railway.

It is interesting to observe what effect this improved equipment will have upon the service of the Liverpool Overhead Railway. The 12 trains of the new type will replace 14 of the old, and these new trains will accommodate exactly the same number of passengers as the old ones. With the previous equipment, the trains ran 144 train-miles per hour, while on the new method they will run 216 train-miles per hour. There was a five-minute headway between the old trains, but, under the new *régime*, this will be reduced to 3½ minutes. In other words, the journey from one end of the line to the other will be made in two-thirds of the time taken on the old method, and what is of great importance, the load on the power station will be more uniform, and, as a consequence, the machinery will be running under more efficient conditions.

As a comparison, the following table is of interest,

showing the scheduled speeds with the new Liverpool equipments and those obtaining on other lines:—

| | Miles per hour, including stops. |
|---|---|
| Liverpool Overhead Railway ... ... ... | 19 |
| Manhattan Elevated „ ... ... ... | 13½ |
| Metropolitan „ „ ... ... ... | 14·1 |
| South Side „ „ (Chicago) ... | 14·6 |
| Lake Street „ „ „ ... | 12½ |
| City and South London ... ... ... ... | 12½ |
| Central London ... ... ... ... ... | 14 |

FIG. 4.—ARMATURE OF 100-H.P. MOTOR

## SALFORD CORPORATION ELECTRICITY WORKS AND TRAMWAYS.

(*Concluded from Vol.* 70, *page* 1067.)

THE switchboards are ranged round the switch room, the traction board being at one side and the lighting board at the other, while the station power and lighting and the meter boards are placed at the end. A massive frame in the middle of the room carries the eight throw-over switches, by means of which the dynamos are connected with either the traction or the lighting circuits. Each of these switches is designed to carry 1,600 amperes, and is mounted on an enamelled slate slab.

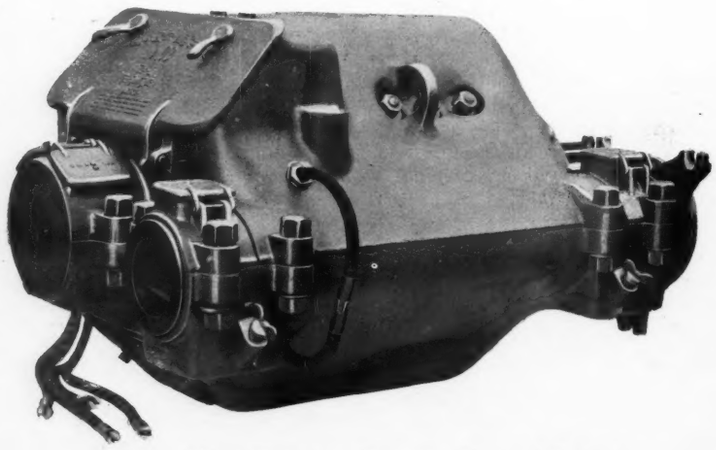


FIG. 5.—100-H.P. MOTOR FOR LIVERPOOL OVERHEAD RAILWAY.

The lighting switchboard was supplied by Mr. S. H. Heywood, of Manchester. It is constructed of black marble slabs bolted to an iron frame; all the connections are brought on to the front of the board. The board is divided into three sections—positive, middle and negative. The first and last of these are identical; each consists of 14 feeder panels, four dynamo panels and four balancer panels. Each feeder panel carries a voltmeter, ammeter, single-pole switch and fuse, and a vertical plug bar. Each dynamo panel has a main switch and Andrews non-return cut-out, ammeter, rheostat and vertical bar. The balancer panels are equipped each with a single-pole switch, fuse, rheostat, bar and ammeter; they also carry four main dynamo fuses.

The centre section provides for five middle-wire feeders, the middle-wire bar, Elliott recording ammeter for earth connection, with a cut-out to prevent injury to the ammeter, and the voltmeter switches.

The voltmeters and ammeters are of the moving coil edgewise type, made by Messrs. Evershed & Vignoles. Three horizontal plug bus bars run across the front of each of the outer boards. A clock is fixed over the centre of the board.

The traction switchboard, which is on the side of the room opposite to the lighting board, consists of eight dynamo panels, nine feeder panels (each providing for two feeders), and a Board of Trade test panel. Each of the dynamo panels carries an I.T.E. circuit-breaker, ammeter, main switch and rheostat. The main switch is divided into two parts, one controlling the positive pole, and the other the negative and equaliser.

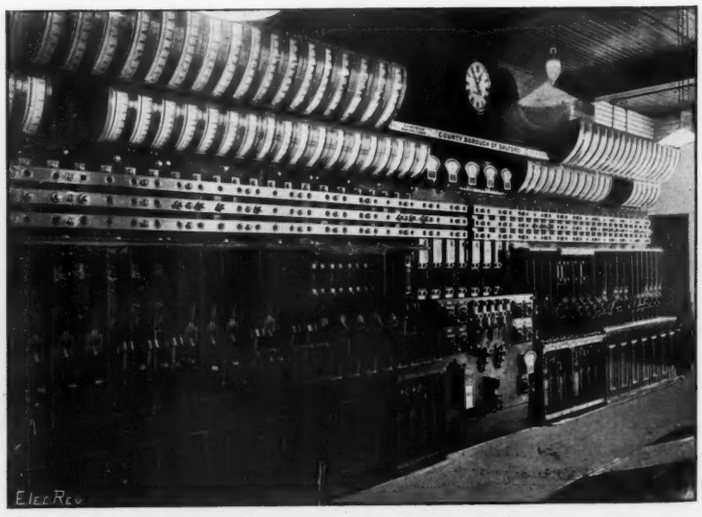
Each feeder panel bears a double set of switches, circuit-breakers, Thomson watt-hour meters and ammeters, for two feeders. Seven of the nine panels are in use.

The B. of T. panel is fitted with a bus bar recording voltmeter, four station voltmeters, four recording ammeters for 1,000 amperes each (in circuit with the return feeders), four recording voltmeters for the drop in the rails (which is generally under 2 volts), leakage ammeter, voltmeter, and the necessary plug switches.

The recording instruments are of Messrs. Elliott Bros.' make; all the rest were made by Messrs. Evershed and Vignoles, either of the edgewise or of the sector type. The board was supplied by Messrs. John Fowler & Co., of Leeds.

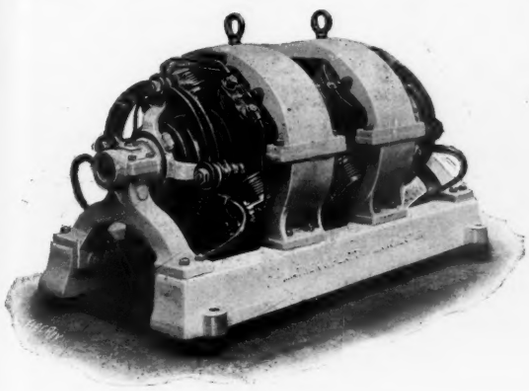
The throw-over switches mentioned above automatically change the connections from shunt to compound when a dynamo is transferred from lighting to traction, or *vice versâ*. On the back of the throw-over board are eight Thomson watt-hour meters for the lighting load.

The station power board, on the end wall of the room, controls a total of 600 H.P., and was made by Messrs. Heaton & Smith. There are five main circuits, with I.T.E. double-pole circuit breakers; there are also four three-pole switches, and



SALFORD: LIGHTING SWITCHBOARD.

one double-pole, with 11 ammeters and voltmeters. In the balancer room below the switch room three Mather and Platt and two E.C.C. balancers are installed; there is also a battery sub-station with balancer in the town. One



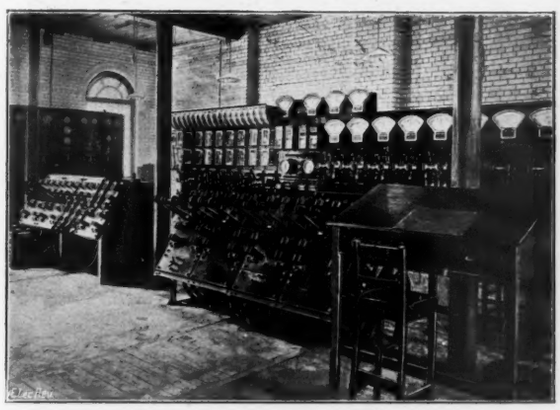
Mather & Platt Balancer.

of the Mather & Platt balancers is shown in the accompanying illustration.

In a building which formerly constituted a sub-station to the alternating current station, immediately adjoining the new works, there are two batteries of Tudor cells, each consisting of 230 cells, having a capacity of 1,200 ampere-hours at a discharge rate of 200 amperes. One of these is used for lighting; the other is employed for traction when the load is light, and during the night. The lighting battery is charged direct from the traction bus bars; the other by the aid of two boosters in the sub-station.

There are also in the sub-station two motor-generators of 60 kw., which were formerly used for converting from A.C. to D.C., but are now driven off the D.C. mains to supply the outlying portions of the district with alternating current. These will be supplemented with two others, consisting of 150-kw. motors driving the old Mather & Platt alternators brought from Walness Road station.

The feeders for the lighting system consist of lead-covered paper and diatrine insulated cables, drawn into Doulton conduits, and varying in cross-section from 1·2 to 0·5 sq. in. They are all two-wire; five returns from the middle wire are brought to the main switchboard. All the feeder junction boxes are in pillars above-ground, so as to be readily accessible. A plan showing the positions of the feeder boxes is given on the next page.

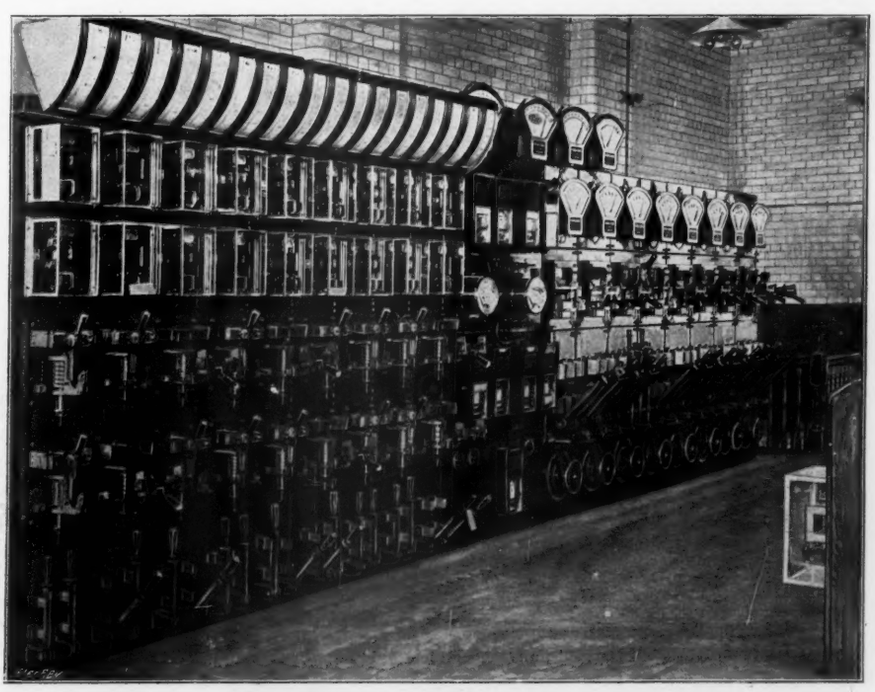


View of Throw-Over Switchboards, Showing also the Traction and Power Boards.

The distributing mains are laid on the solid system, and are in type similar to the feeders; the outers are 0·5 and 0·25 sq. in. in cross-section, the corresponding middle wires being half these respective sections. All the cables were supplied by Messrs. W. T. Glover & Co., Limited.

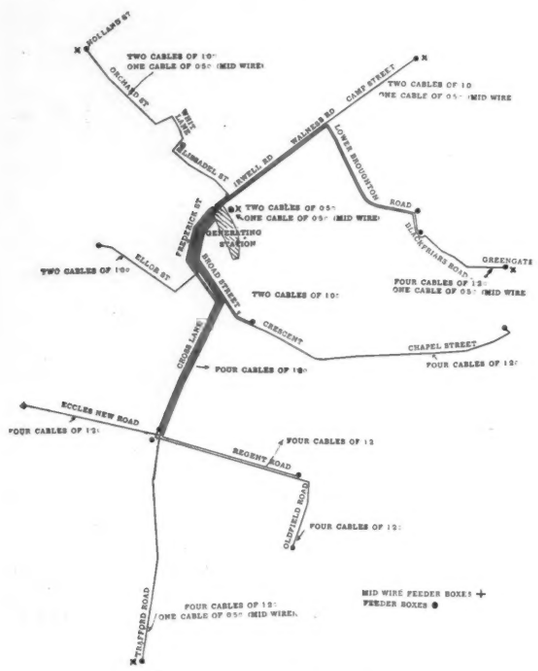
Up to December 31st last there were 70,760 8-c.p. lamps connected, and motors to the amount of 335 h.p. The prices charged are 4½d. for lighting, and 2d. for power. There is a large field for the latter in Salford—more promising, perhaps, than the lighting load—and with the general introduction of direct-current supply, the prospects of this department, no doubt, will materially improve.

The electric tramway system will eventually be one of considerable importance. At present 15 miles of track have been completed, but the ultimate length is to be no less than 50 miles. The maximum grade is 1 in 20, and the sharpest curve 41 ft. 6 in. in radius.



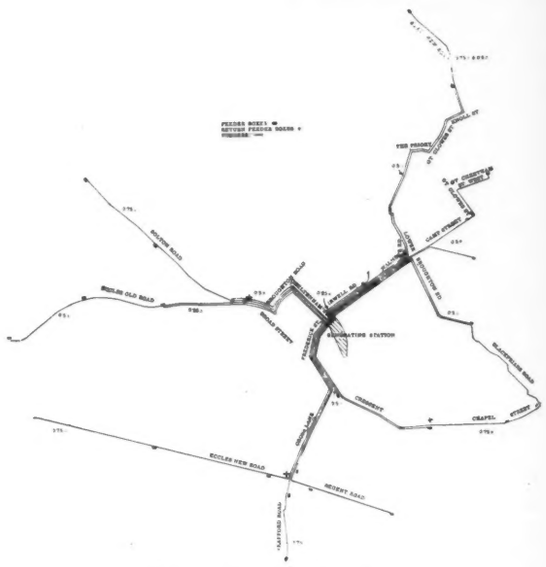
View of Traction Switchboard.

The track is laid on a concrete bed, and consists of 60-ft. girder rails, weighing 103 lbs. per yard. The roadway is paved with granite setts. The joints are double-bonded with Crown flexible copper bonds, equivalent to 0000 S.W.G. in cross-section, and the tracks and rails are cross-bonded at intervals of 120 ft.




Plan of Lighting System.

fitted with flexible suspension, as shown in the accompanying illustration. The guard wires are 7/16 stranded galvanised steel cables. The trolley wire was supplied by Mr. F. Smith, of Salford, and the overhead equipment was carried out by Messrs. George Hill & Co. The steel poles were made by Messrs. J. Russell & Sons.



Plan of Tramway Feeders.

The tramway feeders are of the same type as the lighting feeders, drawn into ducts; they are 18 in number, ranging in cross-section from 0·75 to 0·25 sq. in. There are four return feeders, having a total cross-section of 6 sq. in. A plan of the feeder system is given herewith. The cables were made by Messrs. W. T. Glover & Co., Limited.

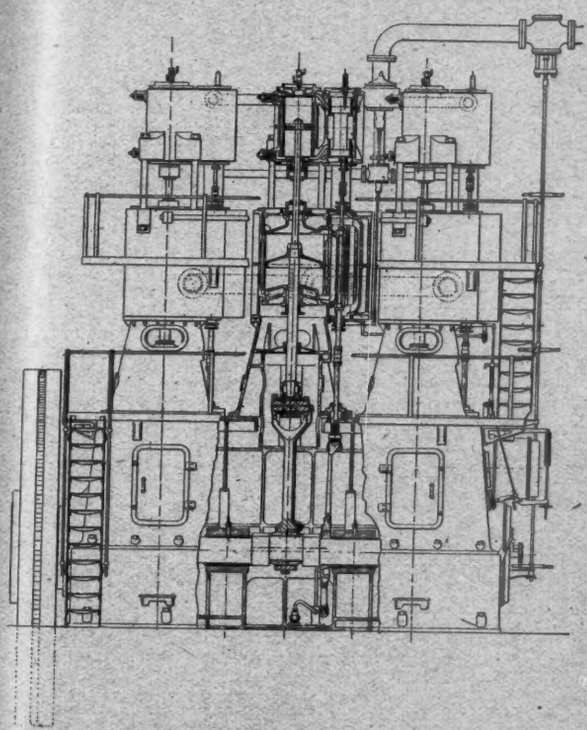
View of Cars and Centre Pole Construction.

The overhead work is carried out mainly with span wire construction, but there is a good deal of centre pole work, The trolley line is divided, as usual, into half-mile sections, the switches being placed in section boxes supplied by

Messrs. Hill & Co. Certain of these boxes are provided with telephones, placed in compartments separated from the main chambers; access to these is gained by means of small doors in the outer case. Brockie-Pell arc lamps have been mounted on the tramway poles on the Pendleton route; these are run nine in series across the outers of the lighting system.

There are 85 double-deck cars at present in use; the number is to be increased to 100. All of these are of the four-wheel type; the bodies were made by Messrs. G. F. Milnes & Co., of Hadley, and are mounted on Brill trucks. The electrical equipments are of the Westinghouse type, the controllers being provided with emergency brake positions. The Blackwell swivel trolley standard is used, with outside springs. Each car carries 55 passengers. Reversed staircases are used, and destination indicators.

A large car depôt, capable of accommodating 180 cars, has been erected in a central position, and is well equipped with workshops, &c.



PART-SECTIONAL ELEVATION OF 1,200-I.H.P. BROWETT-LINDLEY ENGINE.

Some difficulty was experienced in the organisation of the traffic owing to a disagreement between the Corporations of Manchester and Salford with respect to running powers over each other's lines; the borough of Salford penetrates almost to the centre of Manchester, so that facilities for the free exchange of traffic were especially desirable. Happily, negotiations have been set on foot, as the result of which there is no doubt that a satisfactory arrangement will shortly be arrived at.

Mr. Taite, who has entire charge of the electrical systems for lighting and traction, has for chief assistant Mr. T. V. Parsons; Mr. E. H. L. Dickson is mains superintendent, and Mr. J. Collinge is the mechanical engineer for the generating station.

We are indebted to Mr. C. D. Taite for the information upon which the foregoing article is based, and for the facilities which he afforded for the preparation of photographs of the station. Messrs. Lacey, Clirehugh & Sillar, the consulting engineers, and some of the contractors, have also kindly assisted us.

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**Ebbw Vale.**—The directors of the Ebbw Vale Company have offered to supply the U.D.C. with electrical energy for lighting purposes at 2d. per unit, the suggested minimum being 50,000 units. After discussion, the matter was referred to a special meeting.

## ELECTRIC TRACTION NOTES.

(*Continued from page* 19)

**Beckenham.**—The U.C. recently referred to a committee the advisability of promoting a Bill to authorise the Council to construct electric tramways in the town, and to obtain further powers respecting the electricity undertaking.

**Belfast.**—At the meeting of the Corporation on the 1st inst., a special report on the surface contact system of electric traction in operation in Wolverhampton was received from Mr. V. A. H. Cowen, city electrical engineer. The report gave a lucid explanation of the Lorain system.

**Cardiff.**—According to Mr. Andrews, chairman of the Tramways Committee, an offer has been received from a strong syndicate in the town, who are prepared to take over the tramline and pay the Corporation 5 per cent. on the Corporation's electric tramcar outlay.

**Devonport.**—Arbitration proceedings recently became necessary to settle various points regarding the supply of energy by the Corporation to the Devonport and District Tramways Company, and Major P. Cardew has now issued his award. The form and terms of contract between the parties are settled by the arbitrator as follows:—

Whereas the company have constructed certain tramways in the borough of Devonport authorised by the Devonport and District Tramways Act, 1898, and whereas the Corporation have erected and set up an electrical installation for the said borough, and are able therefrom to supply the company with the electric power necessary for properly and efficiently working the said tramways, and whereas under the aforesaid Act the company shall, if required by the Corporation, enter into a contract with the Corporation for such supply of electric power, and whereas the Corporation have required the company in writing to enter into such contract, and whereas the terms of such contract have been settled in the terms following by Major Philip Cardew, appointed at the request of both parties by the Board of Trade for that purpose. Now it is hereby agreed by and between the parties as follows:—

1. The Corporation shall supply and continue to supply to the company, subject to the terms and conditions hereinafter mentioned, such electrical power as the company may require for properly and efficiently working its tramways within the borough.

2. The Corporation shall supply such electrical power at a feeding-point near the Devonport Technical School, or at such other feeding points as may be mutually agreed.

3. The Corporation shall provide at its own cost such electrical cables, mains, feeders, return circuits, and all such other things on the circuit on their side of the feeding point as may be required to enable the company to fulfil its statutory obligations, and to comply with the regulations of the Board of Trade.

4. The electrical power to be supplied by the Corporation to the company shall be of continuous current, at a voltage, measured at the feeding point, varying from 500 volts at no load to 550 volts at the maximum load from time to time required by the company, subject to the variations permitted by the Electric Lighting Acts and the regulations of the Board of Trade.

5. The maximum current to be provided by the Corporation shall not exceed the limit of 1,000 (one thousand) amperes, at which limit the Corporation shall be at liberty to set the cut-out governing the supply, provided that this limit shall at any time be increased, subject to reasonable notice (say, three calender months) given by the company to the Corporation, and that at the end of five years from June 30th, 1901, and of every subsequent period of five years, the said limit shall be made smaller if so required by the company, subject to reasonable notice as aforesaid.

6. The said electrical power shall be supplied between the hours of 5 a.m. and 12 midnight on every day or between such other hours as may from time to time be agreed upon between the company and the Corporation.

7. The Corporation shall pay the tramways company in respect of any interruption of working of tramways due to the defective supply of current from any cause except *force majeure* during the continuance of this agreement as liquidated damages the sum of 10d. in respect of every car-mile which has not been run in consequence of such defective supply, and the company shall be entitled to deduct the said sum from any moneys due from time to time by the company to the Corporation provided that no failure of supply due to a demand for current exceeding the limit laid down in Clause 5 shall be held to be a defective supply of current under this clause.

8. The amount of electrical energy supplied by the Corporation to the company under this agreement should be ascertained by the average readings of three meters fixed at the feeding-point. The said meters to be the property of the Corporation who shall charge a rental to the company for the same as to ordinary consumers under the clause relating thereto in their provisional order. In the event of any of the readings of any meter varying more than 3 per cent. from the mean of the other two whose readings are the closest, then the reading of the third meter shall be disregarded, and the last-mentioned meter shall be disconnected and repaired and recalibrated at the standardising laboratory of the Board of Trade, or at some other recognised and agreed standardising institution at the expense of the Corporation, and in the meantime the quantity of the supply shall be determined by the average of the readings of the other two meters.

9. The company shall pay the Corporation for the electrical energy supplied at the following rates, viz.:—

A minimum charge equal to one hour's supply per diem of the maximum current specified in Clause 5 at 500 volts pressure at 3d. per unit, and for any quantity in excess of such amount at the rate of 1½d. per unit.

10. The readings of the meters shall be taken weekly on Thursday, and the Corporation shall deliver an account to the company every four weeks, stating the number of units supplied to the company by the Corporation during the previous four weeks, in accordance with the readings of the said meters, and the amount payable therefor by the company to the Corporation, and the company shall pay the same within 21 days from the delivery of such account.

This agreement shall remain in force so long as the company or its assigns remain the owners or lessees of the tramways, but no longer, provided that from and after the expiration of a period of five years from June 30th, 1901, and of every subsequent period of five years, the rates of charge fixed by this agreement may be varied as may be agreed between the parties, or, in default of agreement, shall be settled by an arbitrator to be appointed by the Board of Trade upon the application of either party.

It seems that the Corporation had been supplying energy to the tramway company for nearly 12 months before the price was fixed, and as the company's offer and the Corporation's charges were so wide apart it necessitated going to arbitration. The company's original offer was on a sliding scale, viz.:—

1¾d. per unit for the first 100,000 units.
1½d. " " second 100,000 "
1¼d. " " third 100,000 "
1d. " for all over and above.

The Corporation's charge was a flat rate of 2½d. per unit, influenced, no doubt, by the fact that the sister town of Plymouth charges the tramway department 3d. per unit. To avoid going to arbitration, the Corporation reduced their charge by ¼d. per unit,

and the company advanced their offer to 1¼d. per unit all round. As neither party could see their way to a better offer they went to arbitration. Devonport—as is characteristic of all Devon—is very undulating, and the tramway company have at present 25 cars for service, but up to date only 18 run on an average. Their maximum demand is 550 KW. while the units average 17,000 per week of 129 hours. All the routes have steep gradients, the steepest being 1 in 11. The Corporation supply energy in bulk, and provide and maintain cables to a feeding point some 1,100 yards from the works, where the energy is metered. The award as regards price is given on the rebate system, but the Corporation feel somewhat on the point, that while the maximum demand the company can make on the Corporation—stipulated in Clauses 4 and 5—is 550 KW., the units chargeable on the higher rate of 3d., are only on the basis of 500 KW., as stipulated in Clause 9. The result of the award is, under the present working, equivalent to a flat rate of 1·8d. per unit.

**Genoa.**—Consul Keene, reporting on the trade of Genoa and district for the year 1901, states that 5,319 yards of new tramlines were opened in 1901, making a total length of 98,296 yards in use. Of these 7,713 yards represent horse traction, and the remainder—90,583 yards—electric traction. The mean daily number of cars running was 112 motor, and 18 trailer. These made 1,329,010 journeys, covered 4,273,829 miles, and carried 26,742,926 persons during the year. The hilly nature of Genoa and its neighbourhood, Mr. Keene remarks, renders electric traction particularly suitable and popular. Consul Keene directed attention to the necessity of solving the problem of outlet of goods traffic by rail. He pointed out that about 78 per cent. of the goods vans and trucks loaded at Genoa go north over the Appenines, through the long Giovi tunnels, which are reached by lines running in a loop from Sampierdarena to Ronco. These lines run up opposite sides of the Polcevera Valley, and after emerging from their respective tunnels at Busalla and Ronco, join again at the latter place at an altitude of some 1,000 ft. above the sea. The duplication of this line cost the Italian Government about £3,400,000, so that before incurring the expense of a new line through the Appenines, attention is being turned to the possibility of greater development of the traffic capacity of the existing line, at present limited by the length of its tunnels, of which the Ronco one is about 5 miles long. Notwithstanding recently improved ventilation, the smoke which collects in these tunnels and obscures signals necessarily limits the number of trains which can be run through them, and the steep gradient has a similar effect on the length of the trains. It is, therefore, proposed to introduce electric traction on the left line from Sampierdarena to Ronco, reserving it for goods traffic alone, and it is calculated that by this means 2,500 loaded trucks could be sent through daily, providing for the probable requirements of the port for the next 20 years. The electric power for this line would be produced by two steam power stations, placed one at each end of the line, and by a water-power station at Mignanego—about half-way—driven by a fall from the reservoirs of the De-Ferrari-Galliera Aqueduct. Water-power, transmissible by electricity, Consul Keene states, is looked upon by the Italians as the great future competitor of coal for industrial and traction purposes in Italy, and is already significantly styled by them "white coal." Fears of speculative monopolies, however, make the Government very cautious in granting concessions of public water, and, pending the study of fresh protective legislation on the subject, the Bill of 1884, and Regulations of 1893, are considered inadequate, and have been suspended. Such action, Mr. Keene remarks, approved and adopted in the public interest, shows the importance attached to the question, and accounts for the slow development of the use of "white coal."

**London.**—The London United Tramways statistics for the week ended on Friday night last constitute a record, both with regard to the receipts and as to the number of passengers carried. The average number of cars run per day was 131. The total number of passengers carried in the seven days was 1,026,668, or an average of 146,667 per day. The total receipts for the week were £6,289 6s. 8d., and the total number of miles run 112,289. For the working of the cars and the regulation of the traffic 597 men were required.

**Stockton Heath.**—The Parish Council having insisted that roads through which the proposed electric trams from Warrington run shall be widened by the Corporation to 50 ft., so as to minimise danger to children, the town clerk of Warrington has replied that the demands are so unreasonable, that the Parish Council will probably overreach itself, and he is quite sure that the Corporation will not accept an order with the onerous conditions sought to be imposed.

**Tramway Manual.**—The 1902 edition of Duncan's "Manual of Tramways, Omnibuses, and Electric Railways" has been published. Information relating to all the different undertakings is, as usual, set out in a very convenient form for reference purposes. The publication has now reached its twenty-fifth year, and will no doubt be found of great service to those who want ready to hand financial and personal details of the increasing number of electric lines. Of course, with the progress of street traffic facilities, many new accounts have to be included every year, and this headway bids fair to continue for many years to come, making the Manual increasingly valuable. (T. J. Whiting & Sons, Limited, London. 5s.)

**Tube Railways and the L.C.C.**—The London County Council, on Tuesday, adopted a resolution deciding, in view of the probability of proposals for tube railways and other schemes for London locomotion being submitted to Parliament next session, to authorise the Highways Committee to seek an interview with the President of the Board of Trade for the purpose of urging upon him the desirability of the establishment of some statutory authority to deal with such proposals.

## TELEGRAPH AND TELEPHONE NOTES.

**Indian Telephone Companies.**—The gross receipts of the telephone companies of India during the year 1900, are stated to have amounted to £29,005, an increase of £1,583, as compared with the previous year; their average annual earnings during the past five years amount to £25,791. The subscriptions to the Telegraph Department for telephone and similar services rendered during the year amounted to £10,742, being £466 more than the amount of the previous year. The average annual subscriptions for the past five years amount to £9,471.

**Manchester Telephones.**—Some days ago the Telephones Sub-Committee considered a report presented by a deputation, which recently visited Glasgow to inquire into its municipal telephone system. It was resolved that the application to the Post Office for a municipal licence on behalf of the Corporations of Manchester, Salford and Stockport be proceeded with, and that all necessary arrangements be entered into by those Corporations with this object.

**Pacific Cable.**—The *British Australasian* says that the Pacific Cable Board is carrying out its promise to initiate a school of cable telegraphy in Brisbane, whence it will draw qualified operators to man all the stations in Queensland, Norfolk Island, Fiji, Fanning Island, and New Zealand. £4,500 are being spent on the Board's school at Southport, near Brisbane, and pupils have been already advertised for. Altogether, the Board will spend in buildings in Australasia over £30,000, the bulk of the material and labour employed being Australian.

**Telegraphic Interruptions and Repairs:—**

| Cables. | Interrupted. | Repaired. |
|---|---|---|
| Latakia-Cyprus | June 20, 1902 | |
| Communication with Carthagena and Barranquilla (Columbia) | Dec. 8, 1900 | |
| Trinidad-Demerara No. 1 | Aug. 27, 1901 | |
| Communication with Bolama | April 18, 1902 | |
| St. Lucia-St. Vincent | May 8, 1902 | |
| St. Lucia-Grenada | May 8, 1902 | |
| Dominica-Martinique | May 8, 1902 | |
| St. Lucia-Martinique | May 8, 1902 | |
| Guadeloupe-Martinique | May 9, 1902 | |
| **Landlines:** | | |
| Route *viâ* Hanekin on Persian territory | Feb. 24, 1900 | |
| Communication with Tientsin and Taku *viâ* Helampo | July 18, 1900 | |
| Siberian line Tschernjaewa-Blagowestschenck | May 29, 1902 | June 9 |
| All Siberian lines Innokentiewsk-Kadde | | May 30 |

**Telegraphs in German East Africa.**—Vice-Consul Dundas reports that a telegraph line has been completed from Dar-es-Salaam by Mafisiätere, Mrogoro, Kilimatinde to Mpapua. Later on, he states, it is to be continued to Tabora, and eventually to Ujiji, where it will join with the trans-Continental telegraph. Natives and Goanese are employed in telegraph offices, and are said to work the instruments satisfactorily. The new dock at Dar-es-Salaam which has been built at a cost of £30,000 by Messrs. Howaldt & Co., of Kiel, for the Government of German East Africa, is lit throughout by electricity, and repairs and various other operations are done by the same power.

**Wireless Telegraphy.**—A Central News telegram says that Mr. J. D. Spreckels, the Californian sugar magnate, has arranged for an installation of a system of wireless telegraphy between California and Hawaii.

Laffan's New York correspondent says that the United States Navy Department has ordered all ships undergoing repairs to be fitted with wireless telegraphy apparatus. Before finally installing any system, experiments will be made to determine the relative merits of four European systems, including one English.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Amsterdam.**—September 8th. Underground high pressure and low pressure cable system (three-phase, direct and telephone). See "Official Notices" to-day.

**Austro-Hungary.**—Sept. 1st. The municipal authorities of Klausenburg (Kolossvar), Siebenbürgen, are inviting tenders until September 1st, for the establishment in the town of a central station for electric lighting and power purposes. Tenders are to be sent to Bela Fekete Nagy, Kolossvar, from whom particulars may be obtained. See "Official Notices" May 9th.

**Barking Town.**—July 31st. Rails, fishplates, bolts and permanent way construction for the U.D.C. See "Official Notices" to-day.

**Devon.**—July 23rd. Wiring work at Devon County Asylum, 2,000 lamps, booster dynamo and motors, switchboard, and replating battery. See "Official Notices" June 27th.

**Epsom.**—July 18th. Semi-marine dry-back boiler, condensers, pumps, cooling pond, piping, one 150-KW. steam dynamo, switchgear, &c., for electricity works extensions. See "Official Notices" June 20th.

**Falkirk.**—July 14th. Pumps, balancing transformers and motor-generators, storage batteries, switchboard, arc and incandescent lamps, cable work, and travelling crane. See "Official Notices" June 20th.

**Gillingham.**—July 17th. Water-tube boilers, piping, condenser, cooling tower, high-speed engines and 250-KW. three-phase alternators, switchboard, cables, arc lamps, crane and well, for the U.D.C. See "Official Notices" June 20th.

**Ipswich.**—July 5th. Engines and dynamos, storage battery, overhead hand travelling crane, feeders, mains, &c., permanent way construction, and arc lamps. See "Official Notices" June 6th.

**Launceston** (TASMANIA).—September 15th. The Corporation wants tenders for polyphase generating, transmitting, transforming and distributing apparatus, reconstructing existing plant, enclosed arc lamps, &c. See "Official Notices" May 23rd.

**Leskovatz (Serbia).**—July 14th. The municipal council of the town of Leskovatz (Serbia) is open to receive offers for the supply and erection of two turbines of 200-H.P. each, two dynamo-electric machines in connection therewith (for tri-phase current), and the necessary accessory works for the transport of electric energy to Leskovatz, a distance of 17 kilometres, as well as the installation of the city supply cables, &c.

**L.C.C.**—July 15th. 80 double-deck cars with trucks, motors, ploughs, &c. See "Official Notices" June 27th.

**London, S.W.**—July 31st. The War Office wants tenders for a self-propelled lorry (oil). See "Official Notices" April 25th.

**Manchester.**—July 17th. Three electric locomotives. See "Official Notices" to-day.

**Mexborough.**—July 19th. One 100-KW. steam dynamo for the U.D.C. See "Official Notices" to-day.

**Newcastle-upon-Tyne.**—July 10th. The Corporation wants tenders for 2,000 tons of tramway rails and the necessary fishplates for same. City Engineer's Office, Town Hall, Newcastle-upon-Tyne.

**Norway.**—July 7th. The Board of Trade notify that tenders will be received at the Norwegian State Telegraph Department not later than noon on July 7th, for the supply of 256 pair and 204 pair telephone cable, and for Leclanché battery glass. Specifications and conditions can be seen in the Technical Department of the Board of Telegraphs, Christiania.

**Pemberton.**—July 23rd. Cables for the U.D.C. See "Official Notices" to-day.

**Pontypridd.**—July 31st. Cables and dust destructors for the U.D.C. See "Official Notices" to-day.

**Stalybridge.**—July 7th. Three 500-KW. steam-driven three-phase alternators; three 50-KW. continuous current exciters; permanent way, bonding and cable conduits for the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board. See "Official Notices" June 13th.

**Sunderland.**—July 10th. Permanent way, overhead equipment and cables for the Corporation tramways department. See "Official Notices" June 13th.

**Swansea.**—July 10th. Conduits, cables, pilot wires, street boxes, &c., for the electricity department. See "Official Notices" to-day.

**Sydney.**—July 23rd. Complete system of high and low pressure cables, and of arc lamps for street lighting, for the Municipal Council. See "Official Notices" June 13th.

**Valparaiso.**—September 1st. Construction and equipment of electric tramways. Further particulars from the Chilian Consulate.

**Willington Quay.**—July 4th. The Willington Quay and Howdon Industrial Society, Limited, invite tenders for electrical apparatus for power and light at their Bewick Road premises. Specifications and plans, with schedule of quantities, can be had on payment of a fee of 5s. Tenders to be lodged to-day with the chairman of the Committee.

**Wigan.**—July 14th. 1,500 yds. cable. See "Official Notices" to-day.

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CLOSED

**Barnstaple.**—The T.C. has accepted the tenders of the Electrical Company, Limited, and the Simplex Steel Conduit Company, Limited, for fittings for 300 lights at a gross cost of £220.

**Barton.**—The Board of Guardians has decided to light the workhouse by electricity, and on June 18th the tender of Messrs. Browett, Lindley & Co., Ltd., for a compound engine and dynamo, at a cost of £591, was accepted, together with that of Messrs. Collier & Co., of Manchester, for lamps and wiring, for £235.

**Bath.**—The City Council has accepted the following tenders, selected by the engineer, Mr. Teague, from amongst those received for additional plant:—Steam dynamos, Dick, Kerr and Company, London, £4,246; motor alternator, Dick, Kerr & Company, £375; balancer, Dick, Kerr & Co., £250 (the tender for these three items is now reduced to £4,451); transformers, Ferranti, Limited, Hollinwood, £674; arc lamps, Johnson & Phillips, London, £113 9s. 6d.; cables, Callender's Cable Company, London, £1,081; meters, Johnson & Phillips, London, £585 10s.; total £7,304 19s. 6d.

**Bristol.**—The Electrical Committee have accepted the tender of Messrs. Clarke, Chapman & Co., for feed and general service pumps, and the tender of Messrs. Doulton & Co., for water softener for the Temple Back works.

**Dartford.**—The Lancashire Dynamo and Motor Company, Limited, have received the order for a 300-KW. generator through Messrs. Reavell & Co., of Ipswich.

**Dewsbury.**—The Electricity Committee of the Dewsbury Corporation have accepted the tender of Messrs. Cowans, Limited, of Salford, for the erection of a traction switchboard.

**Glasgow.**—The Corporation have accepted the tender of the Telegraph Manufacturing Company for extensions of switch board in the central telephone exchange for an additional 1,000 subscribers.

**Ilford.**—The U.D.C. has accepted the tender of Messrs. Rhodes & Webster, of Bradford, for three motors for the pumping station

**London.**—The London County Council has accepted the tender of W. Jones & Sons, amounting to £4,187, for the erection of a temporary generating station on land adjoining the works of the South London Electric Supply Corporation at Loughborough Junction.

**London.**—The London County Council received the following tenders for the wiring of fire brigade stations:—

BATTERSEA STATION.

| | |
|---|---|
| Cramer & Co. (recommended for acceptance) | £107 10 0 |
| D. Assersohn | 122 10 0 |
| Jackson Bros. | 133 18 0 |
| Mossop & Co. | 146 5 0 |
| Lawrence & Co. | 155 15 0 |
| C. O. Clark & Co. | 175 0 0 |
| Baily, Grundy & Barrett | 226 0 0 |
| Barron & Woodward | 225 0 0 |

CAMBERWELL STATION.

| | |
|---|---|
| Cramer & Co. (recommended) | 94 10 0 |
| D. Assersohn | 109 10 0 |
| Jackson Bros. | 121 8 0 |
| Clark & Co. | 125 0 0 |
| Mossop & Co. | 129 11 0 |
| Lawrence & Co. | 142 0 0 |
| Barron & Woodward | 195 0 0 |

BATTERSEA RIVER STATION.

| | |
|---|---|
| Cramer & Co. (recommended) | 85 10 0 |
| D. Assersohn | 104 0 0 |
| Jackson Bros. | 111 17 0 |
| Mossop & Co. | 120 0 0 |
| Lawrence & Co. | 130 0 0 |
| Clark & Co. | 135 5 0 |
| Baily, Grundy & Barrett | 165 0 0 |
| Barron & Woodward | 198 0 0 |

BATTERSEA PARK ROAD SUB-STATION.

| | |
|---|---|
| Cramer & Co. (recommended) | 35 19 0 |
| D. Assersohn | 48 0 0 |
| Mossop & Co. | 58 11 0 |
| Baily, Grundy & Barrett | 60 0 0 |
| Clark & Co. | 60 0 0 |
| Jackson Bros. | 60 19 0 |
| Lawrence & Co. | 67 10 0 |
| Barron & Woodward | 90 10 0 |

**Swansea.**—The tender of the Mannesmann Company at £1,065 has been accepted for the pipe work, valves, &c., for the new machinery at the electric light station.

**Sweden.**—The Diesel Motor Company, of Stockholm, has secured a contract for a Diesel motor of 120-H.P. for the central station of the Ostersunds Electriska Actiebolaga, Ostersund.

**Tynemouth.**—The tender of the Lancashire Dynamo and Motor Company, Limited, for balancer has been accepted.

**Worthing.**—The T.C. has accepted the following tenders for supplies to the electric light works:—Messrs. Mather & Platt, Limited, for an additional dynamo at the generating station, £1,790; Mr. Thompson, Wolverhampton, for an additional boiler, £650.

## NOTES.

**"Electrical Review" Contents.**—It has been thought by some of our friends that it would be of service if in the current issue of the Electrical Review there were given each week a note of the contents of the preceding week's issue, so that it may be cut out and mounted on card for easy reference. As we are always anxious to meet the wants of our readers as far as possible, we have decided to adopt the idea. The list of contents of our June 27th issue will accordingly be found in our advertisement pages to-day.

**Fatalities, Fires and other Accidents.**—An inquest was held at Stockton on June 23rd, into the death of J. R. J. Beans (44), which occurred at the Stockton electric power station. Deceased's widow stated that he had only been in the employ of the Corporation about a week previous to the accident, which occurred on Wednesday, the 11th inst. She had visited her husband at the hospital, and he had told her that he was wrapped in flames when he received his injuries. Mr. Smith, chief electrical engineer to the Corporation, said there had never been any report of the slightest back-draught blowing open the furnace door previous to the accident in question. He was of the opinion that an explosion of flue gases had taken place in the main flue, or economiser, and that had caused a back-draught. He thought the explosion might have been caused by the gases accumulating in the flues. Mr. Smith said the boiler at which the explosion occurred had been working since December, 1900. In reply to Mr. Faber, he stated that two other similar accidents had occurred the same night, one 30 minutes after the one in question, and the other about 45 minutes after the second. In his opinion these were caused by the same operating reason. There had been successive accumulations of flue gas. Jno. Sowler, said he was called, after the accident, to take the place of Beans. He made the fire up twice, and then, whilst engaged in raking out the fire, flames rushed out and severely burned his right arm and the right side of his face. The jury returned a verdict "that deceased had died from burns accidentally received, and that no blame was attachable to anyone."

Seven woodchoppers, driving in a coster's barrow along the main road to Isleworth, suddenly turned in front of an electric car, and were all thrown out, one of them having his leg broken.

The depôt of the Barrow tramways, owned by the British Electric Traction Company, caught fire on Saturday morning. The roof of the building fell in before the brigade arrived. Ten steam tram engines and four tramcars were completely destroyed, and the rest were considerably damaged. The B.E.T. Co. have just entered into an agreement with the Barrow Corporation for a lease of the tramways, and have decided to put down electric traction. It is probable that Barrow will be without any tram service until the conversion to electric traction has been accomplished.

Damage to the extent of about £50,000 has been caused by a fire which broke out at about midnight on Friday at the premises of Messrs. Goddard, Massey, & Warner, engineers, Nottingham. A large quantity of machinery has been ruined, and between three and four hundred people are thrown temporarily out of employment.

The business premises of Messrs. Furse & Co., electrical engineers, of Traffic Street, Queen's Walk, Nottingham, were badly damaged as the result of this fire. The gable end of a wall fell upon the roof of the premises of Messrs. Furse & Co., and broke a quantity of valuable machinery and fittings. The damage is covered by insurance.

On June 21st, a boy named H. A. Triptree, aged 13, who visited Southend with an excursion party, was paddling on the beach when he climbed up one of the piles which support the tram rails of the pier. Apparently unobserved, he got on the track, placed his bare foot on the conductor and received a shock. He then fell on to the conductor and the outer rail. He was instantly killed, and dropped through the girders among his companions below, a distance of about 16 ft. He was much burned about the thighs and neck. The tramway has been opened for 10 years, and about 900,000 visitors pass on to the pier annually, but this is the first accident of the kind.

At Bradford on June 29th, at 7.30 p.m., an electric car, which was standing at the Thornton terminus minus its driver, started off on its own accord. One account says that, gaining impetus, the vehicle was soon running at express speed, and the passengers, in their frantic endeavours to escape, jumped off. Mrs. White, the wife of a Heaton farmer, was killed almost instantly, alighting on her head, and her son was severely injured, having to be removed to the Bradford Royal Infirmary. Six other persons were injured. Our Bradford correspondent says that the car had contrary to regulations been left by both the driver and conductor, and had been standing for some minutes. Eventually it began to move off down a slight gradient, and one by one many people jumped off. Eventually a passenger with a cool head took the slipper brake in hand and pulled up the car. One of the witnesses at the inquest declared that he saw a man move the lever at the back of the car, as he got on to it. It was pointed out that the regulations efficiently provided against such an occurrence as this, and the jury found that the driver or the conductor, or both, were to blame, though not criminally so. Counsel, who appeared for the Corporation at the inquest, promised that the authorities would do everything in their power to enforce compliance by the drivers and conductors with the regulations framed for the safety of the public, and he held that they had done so in the past.

The *Morning Post* Rome correspondent says that a few days ago there occurred an accident on the electric railway between Milan and Porto Ceresio in which several passengers received injuries, and which might have resulted in serious loss of life but for the presence of mind of the conductors in promptly applying the powerful brakes. The Porto Ceresio Railway is worked on the third-rail system. The line is a single one, and trains ought never to leave a station until the station-master at the next station telegraphs that the line is clear. It seems that the station-master of one station telegraphed to another station-master to stop the up train because he was dispatching the down train. Without waiting for the answer to his message, he dispatched the down train, but a minute later he learned from the other station that the up train had left a moment before his telegram arrived. The inevitable collision took place on a part of the line where the gradient is comparatively steep, and where a curve allows only a small part of the track to be visible at one time. Consequently the conductors of the two trains, each travelling at 40 miles an hour, had only 3 seconds in which to apply the brakes and to lessen the shock. One of them merely put on the brakes, but the other, in addition to using the brakes, reversed the current, so that his train came to an immediate standstill. But for the fatality of the trains having met on a curve, the action taken by the two drivers would have prevented the collision; and as it was, the reversal of the current by one of them lessened the shock to a considerable extent.

On June 21st, while the men employed by Callender's Cable Company were laying the cables and wires under the pavement between Pool and Tuckingmill for the purpose of the electric lighting of Redruth, a wall, which buttressed an old mine burrow to the west of Pool, collapsed, completely burying one of the men, who afterwards succumbed to his injuries.

At Dublin on June 29th, whilst a nurse was wheeling a perambulator, in which were two little children, along the quays, an electric tram collided with the perambulator and smashed it. One of the children was killed, and the other badly injured.

Perhaps the most serious tramway accident which has occurred on English lines happened last Saturday night at Huddersfield. One of the municipal electric lines which had just been completed, was the Almondbury section. In coming down the latter half of the section, which is very steep, the trolley wheel left the wire, extinguishing the lights of the car. It is reported that the driver lost control of the car, and failed to round a curve near the main line. The car crossed the metals and dashed between the pole used for supporting the trolley wires and the front of the Somerset Arms and a grocer's shop beyond. Mrs. Moorhouse, of Longley, who was on the pavement, was forced through the shop window, and so injured that she died on the way to the infirmary. Her daughter Marion was found dead in the shop. Mrs. Edward Taylor, of Almondbury, was on the car at the end where the full force of the concussion was felt, and received such injuries that she died after admission to the Infirmary. Many others were slightly injured, some of them seriously. The car, which is of the newest pattern, was afterwards tested, and the brakes were found to be in good working order.

**Mr. Trotter's Demonstrations.**—Our readers will doubtless have in mind the attitude we took up when commenting upon Mr. Trotter's famous paper on shocks from 500 volts, and the deductions he arrived at from his equally remarkable battery experiments. We could scarcely wish for anything more convincing that our contentions were correct than the following illogical pronouncement recently published by an esteemed contemporary. Touching upon the death of a youth at Southend from the 500-volt tramway rail, the writer thus concludes:—

"This sad fatality serves to illustrate the fact, which Mr. Trotter's demonstrations were designed to emphasise, but which the public is very apt to overlook or misunderstand, viz., that when properly treated, the 500-volt bare conductor is not a serious danger, but that when meddled with, its possibilities of working evil are immense."

If a gun is pointed at one person by another, who pulls the trigger without knowing the weapon is loaded, and the individual aimed at falls dead, then, on the reasoning adopted by our contemporary, it proves that a gun is not a dangerous thing when properly treated.

Mr. Trotter asserted that neither the man in the street, nor the man on a car, runs any risk of taking 500 volts skin to metal.

Our contention was that papers such as that read by the technical adviser to the Board of Trade, which seek to minimise, if not actually to ridicule, the effects of the dangers to which many of us may at any moment be exposed, are far more conducive to the increase of fatal shocks than to safeguarding the public against them.

**An Invitation to Montreal.**—New York *Electricity* says that the British Institution of Electrical Engineers will be invited to attend the next annual meeting of the American Institute, which will be held at Montreal.

**The Engineer Branch of the Royal Navy.**—More painful reading than the May number of the *Transactions of the North-East Coast Institution of Engineers and Shipbuilders* it would be hard to find. It deals chiefly with the position of naval engineers, and it is impossible to read the account of the deputation, in July last, to Lord Selborne, and the answers of the noble lord, without feeling that the interests of the Empire are being worse than trifled with by the Admiralty. Lord Selborne, it will be remembered, confined his reply to the deputation to a series of I don't

admit this, or that, or t'other, which is admitted and deplored by the whole body of British shipping interests. Do we not all know that the complement of engineers is woefully short? Is it not common knowledge that the naval stoker is under-fed, and gets tea-wash when he comes off watch, where the mercantile stoker gets oatmeal hot? Too many absolute breakdowns have already occurred, as in H.M.S. *Hannibal* and *Repulse*, for the country to be soothed by Selbornian platitudes. We are glad to see that the members of the North-East Coast Institute did not mince their words when they were called on to discuss the practical refusal of the Admiralty to do anything. The whole trouble seems to arise from the older naval officers, who despise machinery and all connected with it, and have the ear of the Lords of the Admiralty. The result of this policy is that the Navy cannot get engineers sufficient for its needs; we are nearly 20,000 men short of bare efficiency. Lord Selborne could do no better than refer to the War Office as a pattern or parallel. This, with the lamentable exhibition before him of the South African War, only shows the tone of mind possessed by First Lords. As Prof. Weighton asks, are we to wait for a naval Boer war to reveal the shortcomings of the Admiralty? The trouble must be with the constitution of the Board. It appears to be a mere haphazard concatenation of a few men who have ceased to worry over the Empire's safety. Already the woeful disaster of the Belleville boiler installation has been hushed up. Even the report of the Committee does not appear. When it does appear it may contain very toned-down criticism, and so the farce goes on, with the income tax at 1s. 3d., and ships without men and with rotten boilers. How can the country be safe if the control of the Navy is in the hands of men who, either of their own initiative, or by advice, committed us to the Belleville boiler? How can it be safe when the First Lord is so opposed to reform, that, to quote Prof. Weighton, he states in no ambiguous language that the engineer branch adequately performs its functions; that there is no want of discipline in the engine room or stoke-hold; that there is no lack of men; that the Admiralty get all they ask for, and that it is not expedient to include the engineer element on the Board of Admiralty. Lord Selborne, in fact, practically denied every fact brought forward. It is high time that the Admiralty were swept away to make room for better men, who would show themselves capable of grasping the conditions which will make or mar this Empire.

**Conversazione of the Institution of Electrical Engineers.**—The annual conversazione of the Institution was held on Tuesday last at the Natural History Museum, some of the side galleries of which were thrown open in addition to the central hall and galleries. The President and Mrs. Swinburne, supported by members of the Council, received the guests, who numbered upwards of 1,600. The members of the Incorporated Municipal Electrical Association, and the foreign delegates to the International Tramways and Light Railways Congress, were specially invited, and among those present were Lord Vaux, General Sir C. Wilson, Sir H. Mance, Sir Hiram Maxim, Sir W. H. Preece, Profs. W. Grylls Adams, S. P. Thompson, and J. M. Thomson, Generals Festing and Webber, Col. R. E. Crompton, Mrs. Hertha Ayrton, Messrs. Edmunds, Ferranti, Gavey, Langdon, McMillan, Rider, Siemens, Scotter, Swan, and other distinguished guests and members.

The hall was brilliantly lighted with arc lamps, and the decorations were both tasteful and abundant. The string band of the Royal Engineers, by permission of Major-General Sir T. Fraser, K.C.B., &c., under Lieut. J. Sommer, performed a capital selection in the central hall, while the Leoni Ladies' Quintette discoursed sweet music—in the gallery of Fossil Mammalia, of all places!

At 11 p.m. the first verse of the National Anthem was sung by members and guests, accompanied by the bands, this method having been adopted of expressing congratulation on his Majesty's rapid progress towards recovery. As usual, the proceedings were marked by the greatest sociability, and by the *camaraderie* inseparable from members of the electrical profession.

**The Incorporated Municipal Electrical Association.**—The seventh annual convention of this Association commenced on Wednesday morning in the lecture theatre of the Institution of Mechanical Engineers, Storey's Gate, Westminster, by kind permission of the President and Council. The chairman of the London County Council, Sir John McDougall, met and welcomed the members and friends of the Association in a commendably brief speech. The means of locomotion in London, he said, should be of the very best, and the Municipal Electrical Association must consider what form it should take. The electric light was a comfort to the rich, but the electric tramcar was the poor man's carriage, and was both comfortable and convenient. The members of the Association must encourage municipalities to push forward matters electrical in all directions.

Mr. Rider, this year's President, in thanking Sir John for his welcome to the members, offered the congratulations of the Association upon the honour which had just been conferred upon him by his Majesty the King, and then delivered his Presidential address, which may be found in our other columns. After a vote of thanks, proposed by Mr. Alderman Pearson, of Bristol, had been seconded and carried, Mr. Ruthven Murray was called upon to read his paper on "Double-Current Generators and their Application." A lengthy discussion ensued, in which Messrs. Wordingham, Mountain, Esson, Faraday Proctor, Barnard, Gay, who years ago had prophesied what Mr. Ruthven Murray had there propounded; Scott (America) whose remarks were wholly practical, the double-current generator having been in extensive use for some years in the States; and Rider, took part. Mr. Murray having replied, Mr. Barnard's paper on "High-tension Continuous Current Systems" was read, and discussed by Messrs. J. F. C. Snell, Wylie, Shawfield, Mountain, Burnett, Chamen, Ferranti, and Wordingham. Speaking generally, the tone of the discussion was against the views advanced by both authors.

The afternoon was devoted to visiting the generating station of the Central London Railway at Shepherd's Bush, that of the Metropolitan Electric Supply Company, Limited, at Willesden, and the Works of the Incandescent Electric Lamp Company, Limited, Brook Green, W., where the "Robertson" lamp is manufactured.

The attendance did not strike us as being quite so large as at Glasgow last year, but the attraction of the review of Indian troops within a stone's throw of the conference may have had some influence on the numbers present. In any case, however, Mr. Rider and the council have every reason to feel satisfied with the first day's proceedings.

**The Cape Town Exhibition.**—The scheme for holding a British and Colonial Exhibition at Cape Town for a period of four months from November, 1903, to February, 1904, is making progress. The patronage of Lord Milner has been secured, while others whose support has been enlisted are Sir J. Gordon Sprigg, the Mayor and Corporation of Cape Town, the Chamber of Commerce of Cape Town, Sir Frederick Young, K.C.M.G., vice-president of the Royal Colonial Institute, and others. It has been arranged that the Chamber of Commerce and the Town Council of Cape Town, representing the leading merchants and business men at the Cape, shall appoint an advisory board, in order to forward the arrangements and interests of manufacturers participating in the Exhibition, the main object of which is to bring the machinery and industrial products generally of Great Britain and the Empire before the South African consuming public. The site upon which the Exhibition is to be held adjoins the Botanical Gardens, and is within five minutes' walk of the Town Hall. The promoter and general manager of the Exhibition, Mr. A. P. Baker, who is now in England, will return to South Africa in November, when the preliminary works will have made considerable progress.—*The Times.*

**Electric Traction for Mines.**—The *Sydney Daily Telegraph*, in a Broken Hill dispatch for May 15th, stated that the electric traction plant lately installed at the 640 ft. in the Proprietary mine was that week to be put into regular service. It was to run over approximately 5,500 ft of track already laid, including cross-cuts extending from the Delprat shaft to nearly as far as Block 10 boundary. The plant comprises a small electric locomotive, which develops about 15 H.P., and on the level track runs at about 8 to 10 miles an hour. The motive power is obtained from a direct current generator at 220 to 240 volts, put down for the purpose of developing power sufficient to supply two or three locomotives of the same size. It will easily handle 20 trucks or more if wanted. One horse cannot conveniently draw more than five or six full trucks. Should this principle be extended throughout the mine, surface and underground, it will throw over 100 horses out of service. About 15 horses are employed below the surface each shift, and these have to be carried up and down every change, which entails considerable expense and loss of time.

**Alcohol as a Fuel in Germany.**—A recent article on this subject in *Cassier's Magazine*, by Mr. F. H. Mason, points out the modern development of the German alcohol business. The German spirit is distilled from the potato, which grows plentifully on the sandy soil of North Germany. The process of distilling potato spirit is cheap. The beet sugar molasses is another source of alcohol, and in 1901 Germany used in trade over 30 million gallons of these rough alcohols, denaturised by methyl or other disagreeable substance, and untaxed. This methylated spirit, as it may be termed, is used largely in spirit motors, and it has the advantage of smelling less offensively when burned than the filthy petrols which render the upper Thames less pleasant than formerly. The German spirit industry had an Exhibition in Berlin this spring, where were shown not only the processes of spirit manufacture, but motors and vehicles driven by spirit, as well as other apparatus for its consumption, and its uses in the arts. Theoretically, alcohol is said to have but three-fifths the thermal value of petroleum, but in a motor it is said to give an effect of 28 per cent. against the 15 per cent. of petroleum products. Its present price is about 7d. per gallon (U.S. gallon of 231 cubic in. is probably intended), or 15 marks per hectolitre, and at this it will compete with steam or any other form of heat energy for powers less than 90 H.P., especially on the farms where it is produced. It is used for power and for cooking, also for lighting with mantle burners, in which capacity it leaves petroleum behind, and approaches electricity in illuminating power. Much of Germany's chemical industry is due to a plentiful supply of cheap alcohol; German law has been framed to exempt industrial alcohol denaturised by pyridin, picolin, benzol, talnol, xylol, and similar products, and the exemption has, it is claimed, produced 10 times the profit of the old tax. At the same time, considering the limited food of many of Germany's millions, it is open to question whether the assistance given to alcohol production by the tax, which, we presume, exists on petroleum products, has not drawn from food production land that could have been well employed to grow food, in place of crude alcohol to exclude petroleum. Presumably fuel of some kind must be consumed in distilling alcohol, though the bulk of the energy necessary to compound an alcohol is given by the sunlight, which maintains the living organisms of fermentation. For each pound of spirit distilled, a fraction of the spirit burned would find the heat of distillation. Here, however, it is to be remembered that each

pound of spirit distilled represents other pounds of water raised to 180° F., but of the economies of manufacture of alcohols the article does not treat. Ethyl alcohol, or true alcohol, has the formula $C_2H_6O$, a density of 23, and molecular weight 46. Its vapour weighs 0·12857 lb. per cub. ft. and it requires 9·074 times its weight of air in combustion, or 2·037 times its weight of oxygen, or three times its volume of oxygen. Its comparatively low calorific capacity is due to its oxygen contents being $\frac{16}{46}$, or fully one-third of its total weight. Alcohol is in a sense already partly water, and may be written $C_2H_4 . H_2O$, or hydrated ethylene. The calorific power of ethylene is 21,927 B.T.U., that of alcohol 12,744 only. The addition of methyl, which contains double the water that ethyl contains, still further reduces the calorific capacity, which for methyl is only 9,596. Benzene, on the other hand, has a capacity of 18.094; ethylene of 21,927; methane of 24,017; acetylene of 21,856; ethane of 22,338, figures which, less the effect of endothermism, correspond with the ratio of oxygen required to effect combustion. The petroleums contain little or no oxygen, but have the composition $C_nH_{2n}$, and are thus of much higher calorific capacity than the alcohols. The latter, it is true, burn with a smokeless flame, probably from the presence of the molecule of water in their composition. The figures for the various hydrocarbons and alcohols most known are given in Kempe's "Year Book," p. 148 *et seq.*

**Appointments Vacant.** — Station superintendent at Hammersmith at £200 per annum; electrical engineer for Cleckheaton at £200; engineer-in-charge for Paisley; shift engineers, inspectors, clerks and others for the Bournemouth tramways department.

**Board of Trade and Electric Traction.**—We understand that on Wednesday a conference took place at Westminster between Sir F. Hopwood and Sir H. Jekyll, of the Board of Trade, and the representatives of various municipal and other bodies relating to the new electric traction regulations of the Board of Trade.

**Personal.**—Mr. W. H. Booth has fixed his permanent office at No. 2, Queen Anne's Gate, Westminster, and with a colleague, will deal with questions for testing, steam engineering, furnaces and combustion, water supply and hydrogeology, electric traction and power distribution.

**Gas Plants for Motive Power.**—We have received a copy of a lecture on power gas, by Mr. Gerdes, of the firm of Julius Pintsch. One of the items emphasised in this lecture is that a light bell governor placed on the gas pipe greatly conduces to regular working, and that dependence should not be placed on the main holder. Is not this, after all, the equivalent simply of the india-rubber bag of the town gas-engine? Mere enlarged chambers, of course, will not do; the chamber should possess the power of rapidly contracting in volume. The author proposes a combined water gas and poor gas plant. He uses 12 K of carbon to produce 22·3 $M^3$ of hydrogen and 22·3 $M^3$ of carbonic oxide. This is his water gas. It weighs 30 kilos. Then he uses 12 K carbon, from which he gets another 22·3 $M^3$ of carbonic oxide and 41·2 $M^3$ of nitrogen. This weighs 79·8 K. Finally, for loss of heat and inefficiency he assumes to use 6 K of carbon, out of which he produces 11·15 $M^3$ of useless carbondioxide with 41·2 $M^3$ of nitrogen, weighing 73·8 K. The total use of carbon is 30 K, and the total gas is 183·6 K, containing 22·3 cubic metres of hydrogen, 44·6 of carbonic oxide, 11·15 of carbon dioxide, 82·4 of nitrogen, or a total of 160·45, of which over a third is combustible, or, say, 41½ per cent. by volume, with a calorific capacity of 1,200 calories per cubic metre of the whole product. A separate boiler to produce the steam required uses a fourth or a third as much fuel as the gas producer, which seems to be a heavy price to pay for the additional percentage of combustible gas above the product of an ordinary dry producer. To reduce plant and expense to a minimum, experiments have been made to run on the suction principle, the engine drawing its gas from the furnace, and the air into the furnace or producer, dispensing with boiler and gas holder, the escaping gas at a temperature of 500° to 700° C. being utilised to generate the 10 per cent. by weight of steam required for 183·6 K of gas. The 18 K of steam contain 11,520 calories. If of the escaping heat of the gas only 500° be utilised, this would represent 20,196 calories on a basis of an average specific heat of 0·22 and a weight of 183·6 K. Thus the escaping gas should be more than sufficient to generate all the required steam. The plant consists of producer, gas cooler, or steam generator, condenser, purifier and governor. The whole interior is kept below atmospheric pressure by the action of the engine. The producer is charged through a rotating gate valve, and cleaned below at an ordinary door without interruption of work. The producer is entirely closed below the grate level and draws its air from outside, whither any gas must travel if from any cause a plenum should occur in the apparatus. Various other precautionary appliances are provided to clear away gas from parts to be cleaned. With plant and engines at Hensy-Verviers, the size of which is not stated, the full load fuel consumption was 0·64 K per B.H.P.-hr., or, say, 1·4 lbs. of inferior coke containing 20 per cent. of water and ash. The first engines used 3½ cubic metres of gas per H.P.-hr., but a new engine, with an additional 3 atmospheres of compression, requires only 2·8 metres, and ultimately it is expected to get down to 0·5 K of coke per H.P.-hour. With Belgian anthracite only 0·44 K was needed. In setting a suction plant to work, the producer should be first raised to incandescence by a fan. It is acknowledged that previous patents for suction gas producers have been taken out, but it is claimed that they did not succeed. However, we believe the Taylor plant is a success, and is at work at Messrs. Horne's works at Islington. The old Neigand patents referred to by Mr. Gerdes belong to Messrs. Korting, who only dropped them because they considered pressure gas plants to be better. One of the speakers in the discussion which followed seemed to be surprised that Mr. Gerdes should have found difficulty in using gas of 780 calories capacity per cubic metre, as he had himself used gas successfully as low as 629 calories; 780 calories is about 87½ B.Th.U. per cubic foot. This is a question of some interest. It was the excuse of low calorific capacity that was made to do duty by the unthinking opponents of blast furnace gas utilisation. Compression of the charge, of course, explains why such poor gas can be readily ignited. If the calories per cubic metre be divided by 9, the quotient will be very nearly the British thermal units per cubic foot, so that the low figure of 629 calories is almost exactly 70 B.Th.U. per cubic foot. The correction of the result by 1 per cent. will give the true result with great approximation. Thus 810 calories per $M^3 = 90 + 90 = 90·9$ B.Th.U. per cubic foot; or still better, the calories divided by 9, and the result increased by one-ninetieth, will be closer still, as $810 \div 9 = 90$. $90 + \frac{1}{90}$ of $90 = 91$. In these days of gas engine literature, it is convenient to have such approximations in mind for mental comparisons.

**Partridge Sparklet Fuse.**—Referring to our article on this invention, which appears on another page, we understand that the device has been patented in America and Germany, as well as in this country.

## THE CENTRAL STATION ENGINEER.

THE Gravesend Town Council, on June 25th, appointed Mr. McINNES as resident electrical engineer for a period of five years at a salary of £250 a year.

Mr. J. B. EDMUNDSON, who has resigned his post of resident engineer to the Angus Electric Light and Power Company, Limited, Brechin, was presented with a case of sterling silver and ivory fish knives and forks by the directors, staff, and employés of the Brechin and Montrose districts. Mr. Edmundson afterwards left for Camborne, Cornwall, previous to taking up his new post at Glossop. Mr. Dixon, late assistant at Motherwell, has been appointed Mr. Edmundson's successor.

## CITY NOTES.

### Thomas Parker, Limited.

THE eighth annual meeting was held at the offices, Wednesfield Road, Wolverhampton, on Monday, Mr. W. Thomas presiding.

The CHAIRMAN expressed regret at the absence of the chairman, Alderman C. T. Mander, through a recent accident. As to the report, on the face of it matters did not look quite so favourable as last year, but things were quite as satisfactory as they could expect. They had passed through a time of great trade depression—a depression which was extraordinary, especially in some trades. In one or two with which he was connected nothing like it had been previously felt. The company, in his opinion, went through it very well indeed. Since they commenced the business in 1894, they had paid dividends amounting to 60 per cent., and he thought that an excellent record for such a business, which was a splendid property. They had 20 per cent. more orders than at the corresponding period of last year, and the prices of materials were much reduced, so that altogether they were much better off.

Mr. THOMAS PARKER, in seconding, said they had not up to the present taken the public much into their confidence in respect of the management of the business; but he might say, in regard to the balance-sheet, that they had had one large debt which had to be provided for, and that they had fully depreciated the machinery, &c., of the company to an amount much larger than was the rule with such concerns. Although they did not carry so much forward to the reserve fund, he thought they were very well off indeed, and there were plenty of orders in the shop, which was cause for congratulation.

The report was adopted.

### Rand Central Electric Works.

THE report for 1901, to be presented at the meeting on 8th inst., expresses regret that the war prevented the resumption of operations until September 22nd, 1901, and that from January 20th to that date the whole of the plant was lying idle and totally unremunerative, as the board were of opinion that it would be highly dangerous to re-start the works without having such military protection as would practically ensure immunity from further raids. The statement of accounts shows a loss of £9,570, and adding thereto the amount set apart for depreciation, viz., £8,710, and the balance brought forward from 1899 of £6,951, there

a total debit balance of £25,231. The revenue from all sources amounted to £8,529, as compared with £25,395 for 1900, and the working expenses, including depreciation, to £26,809, against £32,848 for the previous year. The revenue derived from the supply of power amounted to £7,870, as against the revenue for the previous year from the same source of £24,470. The contract with the Johannesburg Municipality alluded to in the last report has been duly completed, and is yielding a satisfactory return to the company. The municipality have already given notice that they will require the full amount of power contracted for—viz., 600 KW. within about six months' time, and 700 KW. from January 1st of next year until the expiration of the agreement. From the returns to hand for the present year, which show a large increase each month (the power supplied for April being more than double that supplied in January), the directors hope that when next they have the honour of calling the shareholders together they will be in a position to report that an increased and remunerative share of the business which it is expected will accrue as a result of the cessation of hostilities in South Africa has been secured by the company.

## South Wales Electric Power Distribution Company.

THE *Financier and Bullionist* says that the directors of the South Wales Electrical Power Distribution Company, Limited, state that the sale of the Act of Parliament obtained by the company in the session of 1900, and of the various contracts entered into by it, to the South Wales Electrical Power Distribution Company (the "Parliamentary" Company), in accordance with the agreement dated April 8th, 1902, and approved by the shareholders at the special general meeting held on April 29th last, has been duly effected. This sale has resulted in a profit to the company of £31,508 10s. The directors have determined to pay an interim dividend for the period to the 30th inst. at the rate of 10 per cent. per annum upon the amounts paid up from time to time in respect of calls due on shares. This dividend will be payable on the 30th inst. The sum of £1,200 for remuneration to the directors, which was voted at the special general meeting on April 29th last, has been paid, and out of the cash balance it is proposed to reserve the necessary amount for the income-tax payable in respect of the £30,000 shares and debenture stock of the Parliamentary Company.

## United River Plate Telephone Company.

THE sixteenth annual general meeting of the proprietors of this company was held on Tuesday at Winchester House, Mr. J. Irving Courtenay presiding.

In proposing the adoption of the report, the CHAIRMAN said the period dealt with in the accounts, the year ending March 31st last, had been in many respects a trying one for all business in the River Plate. Short crops, followed by trade depression attended with many failures, were succeeded by political disquietude and a war scare which seemed likely in December last to culminate in a veritable crisis. However, fortunately for everyone concerned, that acute stage in the affairs of Argentine was averted, and a more settled feeling of security had been established than had existed for a long time in that part of the world—a condition which would be greatly strengthened by the arbitration treaty between Argentina and Chili. Such a series of adverse circumstances could not but leave its mark on every business connected with the country—the rise in the gold premium being the principal result, and it was a matter of surprise that the rise did not reach a much higher figure than it did. The receipts of the company in the River Plate amounted to nearly £115,000, an advance of £5,300, and they would have been more had the gold premium remained at about the average of the previous year. The balances in the accounts were, however, converted at a higher rate by 12 points than was the case a year ago. Similarly, maintenance charges showed an increase of £5,000, due, in a measure, to the higher gold premium. The full benefit of the continued growth of the business was, therefore, not apparent, although the improvement existed none the less. The capital outlay, £25,271, was £5,700 less than that of the previous year, although it was expected to be larger, and it would be substantially more during the current 12 months. Sundry debtors, £14,265, were less by £6,600, mainly on account of advance payments for material being less. Real estate in the River Plate was slightly more. Securities at cost, £120,568, was practically the same, but in view of their forthcoming capital expenditure, it would not remain much longer at that figure. Bills receivable amounted to £15,500, and cash at bankers and at call to £29,098, which were both substantial sums to have in the treasury. The capital items remained the same. They had now, for the first time, a full year's interest on the total issue of the preference shares charged in the accounts, making £2,883 more paid out of their profits. The reserve fund of £35,000 was another strong feature, and would be increased this year to £75,000. The balance of profit, £33,405, did not materially differ from that of the previous year; it would have been substantially increased had the gold premium remained the same. With the amount brought forward there was a balance available of £39,364. It was proposed to continue the dividend of 7 per cent. on the ordinary shares, to place £20,000 to reserve, and carry forward £6,414. The company had recently acquired the business of the Provincial Telephone Company (the Compania Telefonica de la Provincia de Buenos Ayres), in which they had long had an interest, comprising a system of telephone lines connecting several towns with the City of Buenos Ayres, and having exchanges in Bahia Blanca, Mardel Plata and other important places in the province. The lines and plant which had been acquired, were to be improved and considerably extended. The directors had some time since obtained from the province of Cordoba, a concession which was mainly dependent for its value upon a supplementary one being obtained from the City of Cordoba, and that had been recently obtained on favourable terms. The company was proceeding to place in that town a thoroughly up-to-date telephone system, which the directors were assured would prove satisfactory. The company had also other improvements and additions to the business in contemplation, and these were in process of being carried out.

Mr. F. W. JONES seconded the motion.

Dr. ELLIS proposed an amendment to increase the dividend by the payment of a bonus, but it found no seconder, and therefore fell through.

The report was then adopted.

## Angus Electric Light and Power Company.

THE annual general meeting of the above company was held at Montrose on June 18th, Dr. Stone, Montrose, presiding. The balance-sheet showed that the result of six months' working had been a net profit of £43 4s. 5½d. The capital account for Montrose amounted to £22,154 2s. 6d., and that for Brechin to £18,904 2s. 10d. The statement of electricity generated, sold, &c, showed that 13,513 units were generated in Montrose and 18,233 in Brechin.

The CHAIRMAN, in moving that the accounts and balance-sheet for the half-year ended December 31st last be adopted, said that it was satisfactory to be able to state that the result of the six months' work, after paying all expenses, had been a net profit of £42 4s. 5½d., which the directors proposed to carry forward. It was very unusual that the company was at this early stage in a position of having made a profit at all. There had been a considerable movement in the way of introducing motors both in Montrose and Brechin. With regard to the lighting, applications were coming in very freely.

Mr. J. L. AIRD seconded the motion, which was unanimously agreed to.

Ex-Provost Scott, Brechin, was re-elected a director, while Mr. A. Middleton was appointed auditor in the room of Mr. G. G. Vallentine, Brechin, who is removing to London.

## Edmundson's Electricity Corporation.

THE report for the year ended March 31st last, presented at the meeting on Thursday, states that, including the sum of £2,202 brought forward from last year, the net profit, after payment of debenture interest, amounts to £30,962, which, together with the premiums received on new issues of shares and debenture stock, amounting to £6,807, makes a total of £37,770 to be dealt with. After deducting dividend on the preference shares, paid and accrued, amounting to £6,701, and an interim dividend at the rate of 5 per cent. per annum on the ordinary shares, amounting to £4,437, there remains a balance of £26,631, which the directors recommend should be appropriated as follows:—A final dividend on the 35,500 ordinary shares at the rate of 9 per cent. per annum, making 7 per cent. for the year; dividend at the rate of 7 per cent. on 10,000 ordinary shares issued in October, 1901; dividend of 7 per cent. on the deferred shares; to be added to reserve fund, £10,000, leaving to be carried forward to next account, £6,179. Since the last report a central station at Newport, Isle of Wight, has been opened, and powers have been obtained for electric lighting at Ryde, Cowes and Ilfracombe. The undertaking of the Woolwich (District) Electric Light Company, Limited, in which Edmundson's Electricity Corporation has a considerable interest, has been sold to the Corporation of Woolwich upon terms which will allow of a return of upwards of £2 a share to the shareholders of that company. It is intended to complete the sale during the present year. During the year 10,000 preference shares, 10,000 ordinary shares, and £40,000 debenture stock have been issued.

## Deutsch-Atlantische Telegraphengesellschaft.

THE general meeting of the Deutsch-Atlantische Telegraphengesellschaft was held at Cologne on the 30th ult. It was resolved to duplicate the company's system between Emden and New York, and to raise the capital required by the issue of 4 per cent. debentures to the nominal value of £1,000,000 in bonds of £50 each. The 4 per cent. interest on these debentures is guaranteed by a Government subsidy, a proportionate amount of which is held in trust for the debenture holders. The debentures are redeemable at par from 1905. The meeting resolved, after making due provision for reserve, amortisation, &c., that a dividend of 4½ per cent. be distributed on the capital of Mk.21,000,000, carrying to the next account £9,270. The whole of the debentures have been taken up.

**Charing Cross and Strand Electricity Supply Corporation.**—Warrants for the interest on the 4 per cent. debenture stock of this Corporation have been posted.

**Cape Electric Tramways Company.**—The interim dividend of 6 per cent. was payable to all shareholders registered on 1st inst.

**South Lancashire Electric Traction and Power Company, Limited.**—Warrants for the interest to June 30th on the 4½ per cent. first mortgage debenture stock were posted on Monday last.

**Electric Construction Company.**—The directors have resolved to recommend a dividend on the ordinary shares, for the year ended May 31st last, at the rate of 6 per cent. per annum, one-half payable on July 31st, 1902, and the other half on January 31st, 1903.

**City of London Electric Lighting Company.**—The company has declared the following dividend upon the preference shares on account of the distribution for the year ending December 31st, 1902:—6s. per share, or at the full rate of 6 per cent. per annum for the six months ending 30th ult.

## TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—Week ending June 27th, £1,195; last year, £621; increase, £574. Total to date, £18,497; last year, £15,551; increase, £2,946. Miles open, 11½.

Blackpool and Fleetwood Tramways.—Week ending June 28th, £946; last year, £940; increase, £6. Total to date, £9,261; last year, £9,956; decrease, £695. Last year's receipts were for eight days.

Bristol Tramways and Carriage Company.—Week ending June 27th, £5,480; last year, £4,748; increase, £737.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending June 20th:—

| Company. | Amount | Comparison with corresponding week of last year. | | No. of weeks. | Aggregate. | | |
|---|---|---|---|---|---|---|---|
| | | | | | Amount. | Inc. or Dec. | |
| | £ | + £ | − £ | | £ | + £ | − £ |
| Devonport* .. .. | 487 | — | — | 24½ | 9,851 | — | — |
| Dudley-Stourbridge | 718 | 69 | — | 24½ | 16,823 | 2,326 | — |
| Gateshead¶ .. .. | 770 | 265 | — | 24½ | 16,375 | 1,763 | — |
| Greenock-Pt. Glasgow | 528 | 335 | — | 24½ | 10,664 | 6,126 | — |
| Hartlepool .. .. | 277 | 36 | — | 24½ | 5,314 | 411 | — |
| Kidderminster .. | 135 | 16 | — | 24½ | 2,628 | 36 | — |
| Merthyr‡ .. .. | 302 | — | 19 | 24½ | 4,811 | — | 709 |
| Middleton* .. .. | 271 | — | — | 12½ | 3,767 | — | — |
| Oldham-Ashton .. | 589 | 96 | — | 24½ | 12,077 | 136 | — |
| Poole‡ .. .. .. | 250 | 3 | — | 24½ | 5,441 | — | 97 |
| Potteries .. .. | 1,493 | 10 | — | 24½ | 34,585 | 1,211 | — |
| Southport .. .. | 274 | 123 | — | 24½ | 4,997 | 1,504 | — |
| South Staffordshire† | 765 | 50 | — | 24½ | 18,496 | 516 | — |
| Swansea .. .. | 403 | 19 | — | 24½ | 10,549 | 864 | — |
| Taunton* .. .. | 88 | — | — | 24½ | 1,419 | — | — |
| Tynemouth‖ .. .. | 271 | 27 | — | 24½ | 5,846 | 288 | — |
| Wolverhampton Dist. | 145 | 92 | — | 24½ | 3,494 | 2,239 | — |

* Not in operation last year. † Partly steam. ‡ Comparison from April 5th only. § Comparison from March 18th only. ¶ Comparison from May 8th only.

Central London Railway.—Week ending June 21st, £7,577; last year, £6,263; increase, £1,314. Total to date, £169,896; last year, £155,698; increase, £14,198. Miles open, 6. Week ending June 28th, £10,041; last year, £6,145; increase, £3,896. Total to date, £179,437; last year, £161,183; increase, £18,254.

City and South London Railway.—Week ending June 29th, £2,880; last year, £1,875; increase, £1,005. Total to date (26 weeks), £77,345; last year, £51,014; increase, £26,331. Miles open, 6½; last year, 4½.

Dover Corporation Tramways.—Week ending June 21st, £225 4s. 6d.; last year, £225 15s. 8d.; decrease, 11s. 2d. Total to date, £4,757 7s. 6½d.; last year, £4,614 6s. 8½d.; increase, £143 1s. 10d. Miles open, 8. Car miles run, 5,106; last year, 5,106. Number of cars, 11. Week ending June 28th, £294 9s. 7½d.; last year, £239 9s. 4d.; increase, £55 0s. 3½d. Total to date, £5,051 17s. 2d.; last year, £4,853 15s. 0½d.; increase, £198 2s. 1½d. Car miles run, 5,191; last year, 5,118.

Dublin United Tramways Company.—Week ending June 27th:—D.U.T. Co., £4,508 8s. 4d.; D.S.D. Co, £1,254 8s. 6d.; total, £5,757 16s. 10d. Last year—D.U.T. Co., £3,965 4s. 7d.; D.S.D. Co., £948 10s. 4d.; total, £4,908 14s. 11d.; increase, £849 1s. 11d. Aggregate to date, £111,132 17s. 6d.; last year, £106,934 6s. 4d.; increase, £4,193 11s. 2d. Mileage worked, 46.

East Ham Tramways.—Week ending June 21st, £450 2s. 10d.; total to date £19,283 2s. 11½d. Car miles run, 15,192; number of cars, 25. Week ending June 28th, £688 4s. 1d.; last year, £473 14s. 9d.; increase, £214 9s. 4d. Car miles run, 12,052; last year, 6,836. Number of cars, 25; last year, 13.

Glasgow Corporation Tramways.—Week ending May 28th, £13,217 19s. 11d. last year, £11,969 1s. 7d. Total to date, £18,685; last year, £49,276. Passengers carried, 3,612,277; last year, 3,195,086. Car miles run, 249,991; last year, 225,669.

Liverpool Overhead Railway.—Week ending June 29th, £1,690; last year, £1,696; decrease, £6. Total to date, £37,488; last year, £40,981; decrease, £3,493. Miles open, 6 miles 57 chains.

Sunderland Corporation Tramways.—Week ending June 29th, £1,871; last year, £1,251; increase, £620. Total to date (13 weeks), £14,589; last year, £13,201; increase, £1,688. Miles open, 18·7.

## STOCKS AND SHARES

Wednesday Evening.

WITH the turn of the half-year an easier feeling has developed in the money market, and once again it becomes evident that there is plenty of money awaiting investment. Under more propitious conditions, the entry of the second half of the year would probably have been signalised by an advance of investment securities all round, but the illness of his Majesty has stopped business even as it postponed the Coronation. The eyes of Consols wait upon the bulletins from Buckingham Palace, and although at the time of writing the ardently-desired recovery of the King has every chance of becoming a fact accomplished, the City remains somewhat nervous. Fresh commitments are being studiously avoided, and the disposition is to await what news the next week or fortnight may bring forth. Hopes of a sharp advance in prices have come down with the Coronation decorations, and the prophet now points to the end of the holiday season as the probable period for renewed activity in the markets.

Some six-and-twenty stocks and shares marked in our price lists were quoted *ex* dividend last week, but the changes in quotation of the securities affected are but slight, reflecting the amount deducted in the majority of cases. Several have not altered at all. Western Telegraph shares show no trace of having had 3s. per share dividend marked *ex*, and Pacific and European Telegraph Debentures are also unchanged, despite the 2 per cent. shorn off. Commercial Cable stock is quoted at such a ridiculously wide margin, that the dividend of 1½ per cent. is immaterial to the price, but the Debenture stock bears evidence of the 2 per cent. taken off on June 24th.

In the electrical supply list, the end of the half-year shows the usual deductions for interest. Charing Cross 4 per cent. Debenture, both the City of London issues and County of London 4½ per cent. certificates are all quoted *ex* dividend, and so are the two Metropolitan Companies' Debenture stocks and the 3½ per cent. Debenture of the St. James's and Pall Mall. Other than these the fluctuations are uninteresting, Chelsea Debenture, with a rise of 1 per cent., being almost the only security to mark a change. New Charing Cross shares are 8½, and new Westminsters, with 50s. paid up, are about 3½, business being done the other day at that price. Edmundsons are not quotably harder upon the satisfactory results just published.

Electric Constructions are steady at 1½, the dividend declaration at the regular rate of 6 per cent. having been expected. As was the case last year, the amount is to be distributed in equal moieties on July 31st next and six months later. Last year the price of the shares rose to a fraction over 2, and it was never under 1⅞ during the twelvemonth.

"Coronation" traffics are inspiring the Home Railway market towards better prices, and both Central London and City and South London stocks have advanced. For the railway companies it was by no means an ill wind which blew the delaying of the function, because the news arrived too late to greatly affect the rush of people to the Metropolis. Certainly, the "Tube" lines would have done better on the Thursday and Friday than they did under the postponement circumstances, but the number of people who flocked to London beforehand has left its visible mark upon the traffic receipts, and prices are substantially better. It has even converted the substantial District decrease into a microscopic increase for the past six months, but the Metropolitan must be content to end the half-year with a traffic balance on the wrong side, as compared with 1901, although its figures for last week went a good way to reducing the decrease. A fresh reduction in fares came into force on the Metropolitan and District last Tuesday, and determined efforts are being made to recapture some of the combined tram-and-tube traffic. The popularity of this summer's exhibition at Earl's Court is, of course, assisting the District takes to no small extent, and the price of the stock is about 31½. On Central London Ordinary stock the latest dividend estimate ranges from 4½ to 5 per cent.

Great Northern & City Preferred Ordinary stick at 8½. The opening of the line is rapidly becoming a matter of weeks only. The City & Surrey Electric is being widely puffed in directions which, of themselves, might give the investor pause, even though he had not heard it hinted that Mr. H. J. Lawson may be behind the scenes.

British Electric Traction new shares are still a free market about 2½ premium, although the last day for sending in applications expires with Saturday next. The price of the old is now quoted *ex* dividend and rights. Anglo-Argentine Trams at 4½ are a trace easier.

National Telephone varieties keep firm, and the Deferred Stock is a point up on the week. Other telephone issues are without feature.

Some slight reaction after their fall is noticeable in Anglo-American Telegraph stocks, and the three descriptions are all marked higher. The Eastern group remains very quiet, and as regards the rest of the list, the only changes are those already referred to as caused by the interest payments deducted a week ago. Miscellaneous shares also participate in the general dulness of business, but a demand for Globe Telegraph and Trust has to be noted, since quotations do not give any inkling of the purchases which are being made.

## SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Shares. ‡ | Dividends for the last three years. 1899. | 1900. | 1901. | Closing Quotations June 28rd. | Closing Quotation July 2nd. | Business done during week ended July 2nd, 1902. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| £2,300 | African Direct Telegraph, 4 % Debs. | 100 | ... | ... | ... | 99 —103 | 98 —102 xd | 100½ | ... |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | ... | ... | ... | 3½— 4½ | 3½— 4½ | ... | ... |
| 119,700£ | Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. | 100 | ... | ... | ... | 70 — 80 | 70 — 80 | ... | ... |
| 804,720 | Anglo-American Telegraph | Stock | 73/6 | 3½% | 61s. | 44 — 47 | 45 — 48 | ... | ... |
| 3,097,640 | Do. do. 6 % Pref. | Stock | 6 % | 6 % | 6 % | 87 — 89 | 88 — 90 | 89 | 87½ |
| 3,097,640 | Do. do. Deferred | Stock | £1 7s. | 5s. | 2s. | 6½ — 7 | 6¾ — 7½ | ... | ... |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 4 % | 5 % | ... | 3¾— 4¼ | 3¾— 4¼ | ... | ... |
| 13,333,300$ | Commercial Cable | $100 | 8 % | ... | ... | 165 —175 | 170 —180 xd | ... | ... |
| 1,741,029£ | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | ... | ... | ... | 96 — 98 | 96 — 98 xd | 95¾ | ... |
| 16,000 | Cuba Telegraph | 10 | 7 % | ... | ... | 4½— 5½ | 4½— 5½ | 5 | ... |
| 6,000 | Do. 10 % Pref. | 10 | ... | ... | ... | 12½— 13½ | 12½— 13½ | 12½ | ... |
| 12,931 | Direct Spanish Telegraph | 5 | 4 % | 4 % | ... | 2½— 3½ | 2½— 3½ | ... | ... |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | ... | ... | ... | 8½— 9½ | 8½— 9½ | ... | ... |
| 30,000£ | Do. do. 4½ % Debs. | 50 | ... | ... | ... | 100 —103 | 99 —102 xd | ... | ... |
| 60,710£ | Direct United States Cable | 20 | 3½% | 3½% | ... | 9½— 10½ | 9½— 10½ | 10 | 9 1/16 |
| 101,300£ | Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red. | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | 7 % | 7 % | ... | 120 —130 | 120 —130 | 124 | 120½ |
| 1,930,807 | Do. 3½ % Pref. Stock | 100 | ... | ... | ... | 88 — 91 | 88 — 91 | 91 | 88 |
| 1,432,268£ | Do. 4 % Mort. Deb. Stock Red. | Stock | ... | ... | ... | 107 —111 | 107 —111 | 108½ | ... |
| 300,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | 7 % | 12 — 13 | 12 — 13 | 12 5/16 | 12 |
| 320,000£ | Do. 4 % Deb. Stock | Stock | ... | ... | ... | 108 —113 | 108 —113 | 109 | ... |
| 300,000£ | Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909 | 100 | 5½% | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 200,000£ | Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—3,000 | 25 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 180,227 | Globe Telegraph and Trust | 10 | 5½% | 5½% | ... | 8 — 9 | 8 — 9 | 8 1/16 | 8½ |
| 180,042 | Do. do. 6 % Pref. | 10 | ... | ... | ... | 12½— 13½ | 12½— 13½ | 13½ | 12¾ |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | ... | 15 % | ... | 25 — 27 | 25 — 27 | ... | ... |
| 75,000 | Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | ... | ... | ... | 103 —103 | 99 —102 xd | 99½ | ... |
| 17,000 | Indo-European Telegraph | 25 | 10 % | 10 % | 10 % | 37 — 41 | 37 — 41 | ... | ... |
| 100,000£ | London Platino-Brazilian Telegraph, 6 % Debs. | 100 | ... | ... | ... | 100 —104 | 100 —104 | ... | ... |
| 72,680 | Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 | 1 | 2½% | ... | ... | ¼— ¼ | ¼— ¼ | ... | ... |
| 86,492 | Do. do. do. 5 % Pref., Nos. 1 to 86,492 | 1 | 5 % | ... | ... | ¾— 1 | ¾— 1 | ... | ... |
| 983,333 | National Telephone, Pref. Stock | 100 | 5 % | 5 % | 5 % | 95 — 99 | 95 — 99 | 95½ | ... |
| 200,000 | Do Pref. shares | 2 | ... | 3⅛ | 3⅛ | 3½— 3⅝ | 4⅛— 4⅜ | ... | ... |
| 1,966,667 | Do Def. Stock | 100 | ... | 60 | 64 xd | 53 — 57 | 54 — 58 | 58 | ... |
| 15,000 | Do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 12 — 14 | 12 — 14 | 12½ | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 12 — 14 | 12 — 14 | ... | ... |
| 250,000 | Do. 5 % Non-cum. 3rd Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 4½— 5½ | 4½— 5½ | ... | ... |
| 2,000,000£ | Do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 3½% | 94 — 97 | 93 — 96 xd | 94⅜ | ... |
| 500,000£ | Do. 4 % Deb. Stock Red. | 100 | ... | 4 % | 4 % | 103 —107 | 102 —106 xd | ... | ... |
| 171,504 | Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid | 1 | 5 % | 6 % | 6 % | 1⅛— 1 1/16 | 1⅛— 1 1/16 | ... | ... |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | ... | ... | ... | 99 —102 | 99 —102 xd | ... | ... |
| 11,839 | Reuter's | 9 | 5 % | 5 % | ... | 6½— 7½ | 6½— 7½ | ... | ... |
| 3,303 | Submarine Cables Trust | Cert. | ... | ... | ... | 110 —120 | 110 —120 | ... | ... |
| 58,000 | United River Plate Telephone | 5 | 7 % | ... | ... | 5 — 5½ | 5 — 5½ | ... | ... |
| 40,008 | Do. do. 5 % Cum. pref. Nos. 1—40,000 | 5 | ... | ... | ... | 4¾— 5½ | 4¼— 5 xd | ... | ... |
| 179,947£ | Do. do. 5 % Debs. | Stock | ... | ... | ... | 103 —106 | 103 —106 | 103 | 102½ |
| 155,600 | West African Telegraph, 5 % Debs. | 100 | ... | ... | ... | 99 —102 | 100 —103 | ... | ... |
| 30,008 | West Coast of America, Nos. 1—30,000 and 53,001—53,008 | 2½ | ... | ... | ... | ⅛— ⅜ | ⅛— ⅜ | ... | ... |
| 150,000£ | Do. do. 4 % Debs., 1—1,500 gua. by Brzs. Sub. Tel. | 100 | ... | ... | ... | 99 —102 | 97 —100 xd | ... | ... |
| 207,930 | Western Telegraph, Ltd., Nos. 1—207,930 | 10 | 7 % | 7 % | ... | 11½— 12½ | 11¾— 12½xd | 11⅞ | 11⅝ |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 | 100 | ... | ... | ... | 102 —105 | 101 —104 xd | ... | ... |
| 348,777£ | Do. do. 4 % Deb. Stock Red. | 100 | ... | ... | ... | 99 —102 | 97 —100 xd | ... | ... |
| 88,321 | West India and Panama Telegraph | 10 | 5% | ... | ... | ⅜ — ⅝ | ⅜— ⅝ | ... | ... |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. | 10 | ... | ... | ... | 5½— 5⅝ | 5½— 5⅝ | ... | ... |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | ... | ... | ... | 3½— 4½ | 3½— 4½ | ... | ... |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | ... | ... | ... | 101 —104 | 99 —102 xd | ... | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 100,000 | Blackheath and Greenwich Dist. Electric Light, Ord. | 1 | ... | ... | ... | ¼— ⅜ | ¼— ⅜ | ... | ... |
| 100,000 | Do. 4½% 1st Deb. Stock, Prov. Certs. | 100 | ... | ... | ... | 100 —104 | 100 —104 | ... | ... |
| 12,661 | Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 12,761 | 5 | 6 % | 6 % | 8 % | 9 — 9½ | 9 — 9½ | ... | ... |
| 20,000 | Do. do. 7 % Cum. Pref. | 5 | ... | ... | ... | 9 — 9½ | 9 — 9½ | ... | ... |
| 50,000 | Charing Cross and Strand Electricity Supply | 5 | 9 % | 9 % | 10 % | 9 — 10 | 9 — 10 | 9½ | ... |
| 50,000 | Do. do. do. do. 4½% Cum. Pref. | 5 | ... | ... | ... | 5½— 5⅝ | 5½— 5⅝ | 5⅝ | ... |
| 250,000 | Do. do. do. 4% Deb. Stock Red. | 100 | ... | ... | ... | 106 —108 | 105 —107 xd | 105⅝ | ... |
| 34,000 | *Chelsea Electricity Supply, Ord. | 5 | 6 % | 5½% | 4 % | 5 — 5½ | 5 — 5½ | 5½ | ... |
| 150,000£ | Do. do. do. % Deb. Stock Red. | Stock | ... | ... | ... | 108 —111 | 109 —112 | ... | ... |
| 79,579 | City of London Electric Lighting, Ord. 40,001—110,579 | 10 | 4 % | 0 % | 5 % | 8 — 9 | 8 — 9 | ... | ... |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 | 10 | 6 % | 6 % | ... | 11½— 12½ | 11½— 12½ | ... | ... |
| 400,000£ | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | ... | ... | ... | 123 —128 | 121 —126 xd | ... | ... |
| 200,000 | Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid | 100 | ... | ... | ... | 103 —106 | 101 —104 xd | ... | ... |
| 40,000 | County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000 | 10 | 4 % | 4 % | 4 % | 7½— 8½ | 7½— 8½ | 8½ | 8 1/16 |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | ... | 12 — 13 | 12 — 13 | 12 | ... |
| 400,000£ | Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. | ... | ... | ... | ... | 109 —112 | 108 —111 xd | ... | ... |
| 35,500 | Edmundson's Elec. Corp., Ord. Shares | 5 | 6 % | 7 % | 7 % | 6½— 6⅝ | 6½— 6⅝ | 6 1/16 | ... |
| 20,000 | Do. do. 6 % Cum. Pref. | ... | ... | ... | ... | 5⅝— 6½ | 5⅝— 6½ | ... | ... |
| 120,000£ | Do. do. 4½ % 1st Mort. Deb. Stock. | 100 | ... | ... | ... | 108 —111 | 107 —110 | 108 | 107½ |
| 21,009 | Kensington and Knightsbridge Electric, Ord. | 5 | 11% | 12% | 10% | 10 — 11 | 10 — 11 | ... | ... |
| 90,000 | Do. do. do. 4 % Deb. Stock | Stock | ... | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 110,000 | London Electric Supply Corporation, Limited, Ord. | 3 | ... | ... | ... | 1½— 1⅝ | 1½— 1⅝ | ... | ... |
| 49,340 | Do. do. do. do. 6 % Pref. | 5 | ... | ... | ... | 4 — 4½ | 4 — 4½ | ... | ... |
| 250,000£ | Do. do. do. 4% 1st Mt. Db. Stock Rd. | Stock | ... | ... | ... | 94 — 99 | 94 — 99 | ... | ... |
| 98,769 | Metropolitan Electric Supply, 101 to 62,500 | 10 | 5 % | 6 % | 6½% | 16 — 17 | 16 — 17 | 16⅝ | ... |
| 220,000£ | Do. 4½% First Mortgage Debenture Stock | ... | ... | ... | ... | 111 —115 | 109 —113 xd | ... | ... |
| 250,000£ | Do. 3½% Mort. Deb. Stock Red. | Stock | ... | ... | ... | 98 —101 | 98 —101 xd | ... | ... |
| 8,652 | Notting Hill Electric Lighting | 10 | 7 % | 7 % | 6 % | 14 — 15 | 14 — 15 | ... | ... |
| 40,000 | St. James's and Pall Mall Electric Light, Ord. | 5 | 14½% | 14½% | 14½% | 14½— 15½ | 14½— 15½ | 15½ | ... |
| 20,000 | Do. do. 7 % Pref., 20,001 to 40,000 | 5 | 7 % | 7 % | 7 % | 8½— 9½ | 8½— 9½ | ... | ... |
| 150,000£ | Do. do. 3½ % Deb. Stock Red. | 100 | ... | ... | ... | 98 —101 | 97 —100 xd | ... | ... |
| 12,000 | Smithfield Market Elect. Supply, Ord. | 5 | ... | ... | ... | 1⅞— 2⅛ | 1⅞— 2⅛ | ... | ... |
| 50,000£ | Do. do. 4 % Deb. | 100 | ... | ... | ... | 80 — 90 | 80 — 90 | ... | ... |
| 65,000 | South London Electricity Supply, Ord. | 5 | ... | ... | ... | 2⅞— 3⅛ | 2⅞— 3⅛ | ... | ... |
| 109,518 | Westminster Electric Supply, Ord. | 5 | 13 % | 16½% | 10½% | 11 — 12 | 11 — 12 | ... | ... |

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year, consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

## SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

| Present Issue. | NAME. | Stock or Share. | Dividends for the last three years. 1899. | 1900. | 1901. | Closing Quotation June 22nd. | Closing Quotation July 2nd. | Business done week ended July 2nd, 1902. Highest | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 20,000 | British Aluminium 7 % Cum. Pref. ... ... ... ... | £ 10 | ... | ... | ... | 4½ — 5½ | 4½ — 5½ | ... | ... |
| 800,000‡ | Do. do. 5 % 1st Mort. Deb. Stock Red. ... | Stock | ... | ... | ... | 86 — 90 | 86 — 90 | ... | ... |
| 62,071‡ | British Electric Traction ... ... ... ... ... | 10 | 6 % | 9 % | 9 % | 12½ — 13½ | 12 — 13 | 12⅞ | 12½ |
| 90,000 | Do. do. 6 % Cum. Pref. ... ... ... | 10 | ... | ... | ... | 12 — 12½ | 12 — 12½ | 12⅝ | 11½ |
| 600,000‡ | Do. do. 5 % Perpetual Debenture Stock ... | Stock | ... | ... | ... | 124 —127 | 124 —127 | 125½ | ... |
| 70,000 | British Insulated Wire Ord. ... ... ... ... ... | 5 | 20 % | 15 % | 10 % | 7½ — 8½ | 7½ — 8½ | ... | ... |
| 70,000 | Do. do. 6 % Cum. Pref. ... ... ... | 5 | ... | ... | ... | 5½ — 6 | 5½ — 6 | ... | ... |
| 50,000 | ¶Browett, Lindley & Co. (1899), Ord. ... ... | £1 | ... | 8 % | ... | 13s. to 15s. | 13s. to 15s. | ... | ... |
| 50,000 | ¶ " " " 6 % Cum. Pref. ... | £1 | ... | 6 % | ... | 16/6 to 17/0 | 16/6 to 17/0 | ... | ... |
| 105,731 | Brush Elecl. Engng., Ord., 1 to 105,731 ... ... | 2 | 5½ % | 5 % | Nil | 1½ — 1⅝ | 1½ — 1⅝ | 1½ | ... |
| 150,000 | Do. do. Non-cum. 6 % Pref. ... ... ... | 2 | 6 % | 6 % | 3 % | 1⅞ — 2⅛ | 1⅞ — 2⅛ | 1⅞ | ... |
| 125,000‡ | Do. do. 4½ % Perp. Deb. Stock ... ... | Stock | ... | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 125,000‡ | Do. do. 4½ % Perp. 2nd Deb. Stock ... | Stock | ... | ... | ... | 95 —100 | 95 —100 | ... | ... |
| 30,000 | Cailender's Cable Construction shares, Nos. 1—30,000 ... | 5 | 15 % | 15 % | 20 % | 16 — 17 | 16 — 17 | ... | ... |
| 40,000 | Do. do. 5 % Cum. Pref. ... ... ... | 5 | ... | ... | ... | 5⅜ — 6⅛ | 5½ — 6 xd | ... | ... |
| 90,000‡ | Do. do. 4½ % 1st Mort. Deb. Stock Red ... | Stock | ... | ... | ... | 111 —115 | 109 —113 xd | ... | ... |
| 1,969,800 | Central London Railway, Ord. Stock ... ... ... | Stock | ... | ... | 4 % | 104 —107 | 106 —109 | 108 | 103½ |
| 440,100 | Do. do. 4 % Pref. Stock ... ... ... | Stock | ... | ... | 4 % | 105 —108 | 106 —109 | 105½ | ... |
| 440,100 | Do. do. Def. do. ... ... ... | Stock | ... | ... | 4 % | 100 —103 | 103 —106 | 102½ | 100½ |
| 855,000 | City and South London Railway ... ... ... ... | Stock | 1⅞% | 1½% | 2 % | 71 — 74 | 71 — 74 | 72 | 71½ |
| 54,000 | Crompton & Co., Nos. 1 to 54,000 ... ... ... ... | 3 | 7½% | 8 % | ... | 3 — 3½ | 3 — 3½ | 3½ | ... |
| 100,000‡ | Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red | ... | ... | ... | ... | 103 —108 % | 101 —106 % | ... | ... |
| 99,261 | Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261 | 5 | 6 % | 2½% | ... | ⅛ — ¼ | ⅛ — ¼ | ... | ... |
| 17,139 | Do. do. do. "A" Shares, 01—017,139 ... | 5 | 6 % | 2½% | ... | 1½ — 2½ | 1½ — 2½ | ... | ... |
| 344,023‡ | Do. do. do. 4 % Deb. Stock Red ... | 100 | ... | ... | ... | 75 — 80 | 73 — 77 xd | ... | ... |
| 100,000‡ | Do. do. do. 5% 2nd Deb. Stock Prov. Certs. all pd. | 100 | ... | ... | ... | 82 — 87 | 82 — 87 | ... | ... |
| 112,100 | Electric Construction, 1 to 112,100 ... ... ... | 2 | 6 % | 6 % | 6 % | 1⅞ — 1⅞ | 1⅞ — 1⅞ | ... | ... |
| 31,390 | Do. do. 7 % Cum. Pref., 1 to 31,390... ... | 2 | ... | ... | ... | 2½ — 3 | 2½ — 3 | ... | ... |
| 182,500‡ | Do. do. 4 % Perp. 1st Mort. Deb. Stock ... | Stock | ... | ... | ... | 99 —102 | 99 —102 | ... | ... |
| 18,000 | General Elec. Co. (1900) 5 % Cum. Pref. ... ... | 10 | ... | ... | ... | 10 — 10½ | 9¾—10¼xd | ... | ... |
| 150,000 | Do. do. 4 % Mort. Deb. ... ... ... | Stock | ... | ... | ... | 98 — 101 | 98 —101 | ... | ... |
| 35,000 | Henley's (W. T.) Telegraph Works, Ord. ... ... | 5 | 15 % | 20 % | 20 % | 16½ — 17 | 16 — 17 xd | 16 1/16 | 16½ |
| 35,000 | Do. do. do. 4½ % Pref. ... ... | 5 | 4½% | 4½% | ... | 5½ — 6 | 5½ — 6 | ... | ... |
| 50,000‡ | Do. do. do. 4½ Mort. Deb. Stock... | Stock | ... | ... | ... | 111 —115 | 111 —115 | ... | ... |
| 50,000 | India-Rubber, Gutta-Percha and Telegraph Works ... | 10 | 10 % | 10 % | ... | 21 — 22 | 21 — 22 xd | 21½ | ... |
| 800,000‡ | Do. do. do. 4 % 1st Mort. Deb ... ... | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | 3½% | 3½% | 1½% | 4 1/16 — 4 1/16 | 4 1/16 — 4 1/16 | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... ... | 10 | 5 | ... | ... | 10½ — 11 | 10½ — 11 | ... | ... |
| 7,500 | Parker (Thomas), Limited, Ord., Nos. 1 to 7,500 ... ... | 10 | ... | ... | ... | ... —16⅜ | 15½— 16½ | ... | ... |
| | §Rosling & Fynn 6 % Cum. Pref. ... ... ... ... | £1 | ... | 6 % | ... | 19/0 to 20/0 | ... — ... | ... | ... |
| 37,350 | Telegraph Construction and Maintenance ... ... ... | 12 | 15 % | 17½% | 20 % | 34 — 37 | 34 — 37 | 36 | 34½ |
| 150,000‡ | Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ... | 100 | ... | ... | ... | 103 —106 | 101 —104 xd | ... | ... |
| 25,000 | Telegraph Manufacturing, Ord. Nos. 1 to 25,000 ... ... | 5 | 12 % | 12 % | ... | 9½ — 10½ | 9½ — 10½ | ... | ... |
| 20,000 | Do. do. 5 % Cm. Prf. Nos. 1 to 20,000... | 5 | ... | ... | ... | 5½ — 6 | 5½ — 6 | ... | ... |
| 540,000‡ | Waterloo and City Railway, Ord. Stock ... ... ... | 100 | 3 % | 3 % | 3 % | 93 — 96 | 93 — 96 | 95 | ... |

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—¼.
National Electric Free Wiring, —1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅞—10¾.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

## MARKET QUOTATIONS, Wednesday, July 2nd.

| CHEMICALS, &c. | | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|---|
| a Acid, Hydrochloric ... .. | per cwt. | 5/- | 5/- | .. |
| a " Nitric .. .. .. | per cwt. | 22/- | 22/- | .. |
| a " Oxalic .. .. .. | per cwt. | 32/- | 32/- | .. |
| a " Sulphuric .. .. .. | per cwt. | 5/6 | 5/6 | .. |
| a Ammoniac, Sal .. .. .. | per cwt. | 42/- | 42/- | .. |
| a Ammonia, Muriate (crystal) .. | per ton | £38 10 | £38 10 | .. |
| a " " " .. | per ton | £30 | £30 | .. |
| a Bleaching powder .. .. | per ton | £7 | £7 | .. |
| a Bisulphide of Carbon .. .. | per ton | £15 | £15 | .. |
| a Borax .. .. .. .. | per ton | £13 | £13 | .. |
| a Benzole (90 %) .. .. .. | per gal. | 7/- | 7/- | .. |
| a " (50/90%).. .. .. | per gal. | 5/6 | 5/6 | .. |
| a Copper Sulphate .. .. | per ton | £19 | £19 | .. |
| a Lead, Nitrate .. .. .. | per ton | £24 | £24 | .. |
| a " White Sugar .. .. | per ton | £31 | £31 | .. |
| a " Peroxide .. .. .. | per ton | £27 10 | £27 10 | .. |
| a Methylated Spirit .. .. | per gal. | 2/6 | 2/6 | .. |
| a Naphtha, Solvent (90% at 160° C), | per gal. | 5/6 | 5/6 | .. |
| a Potash, Bichromate, in casks.. | per lb. | 5d. | 5d. | .. |
| a " Caustic (75/80%) .. | per ton | £24 | £24 | .. |
| a " Bisulphate .. .. | per ton | £35 | £35 | .. |
| a Shellac .. .. .. .. | per cwt. | 110/- | 110/- | .. |
| a Sulphate of Magnesia .. .. | per ton | £4 10 | £4 10 | .. |
| a Sulphur, Sublimed Flowers .. | per ton | £8 5 | £8 5 | .. |
| a " Recovered .. .. | per ton | £5 10 | £5 10 | .. |
| a " Lump .. .. .. | per ton | £5 | £5 | .. |
| a Soda, Caustic (white 76 %) .. | per ton | £10 15 | £10 15 | .. |
| a " Crystals .. .. .. | per ton | £8 | £8 | .. |
| a Bichromate, casks .. | per lb. | 3½d. | 3½d. | .. |

| METALS, &c. | | | | |
|---|---|---|---|---|
| b Aluminium Ingots, in ton lots | per ton | £148 | £148 | .. |
| b " Wire, in ton lots | per ton | £224 | £224 | .. |
| b " Sheet, in ton lots | per ton | £191 | £191 | .. |
| p Babbitt's metal Ingots.. .. | per ton | £40 to £140 | £40 to £140 | .. |
| c Brass (rolled metal 9" to 12") basis | per lb. | 6¾d. | 6¾d. | .. |
| c Tube (brazed) .. .. | per lb. | 8¼d. | 8¼d. | .. |
| c " " (solid drawn) | per lb. | 7d. | 7d. | .. |
| c " Wire, basis .. .. | per lb. | 7d. | 7d. | .. |
| c Copper Tubes (brazed) .. | per lb. | 8½d. | 8½d. | .. |
| c " " (solid drawn) .. | per lb. | 9d. | 9d. | .. |
| g Copper Bars (best selected) .. | per ton | £69 | £69 | .. |

| METALS, &c. *(continued.)* | | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|---|
| g Copper Sheet .. .. .. | per ton | £69 | £69 | .. |
| g " Rod .. .. .. | per ton | £69 | £69 | .. |
| g " Electrolytic) Bars | per ton | £68 | £68 | .. |
| g " " Sheets | per ton | £75 | £75 | .. |
| g " " Rod .. | per ton | £68 | £68 | .. |
| g " " H.C. Wire | per lb. | 8d. | 8d. | .. |
| f Ebonite Rod .. .. .. | per lb. | 2/- | 2/- | .. |
| f " Sheet .. .. .. | per lb. | 2/- | 2/- | .. |
| n German Silver Wire .. .. | per lb. | 1/5 | 1/5 | .. |
| h Gutta-percha fine .. .. | per lb. | 2/- | 2/- | .. |
| h India-rubber, Para fine .. .. | per lb. | 2/11½ to 3/0½ | 2/11½ to 3/0½ | .. |
| f Iron, Charcoal Sheets .. .. | per ton | £18 | £18 | .. |
| f " Pig (Cleveland warrants) .. | per ton | 49/9 | 49/8 | 1d. inc. |
| f " Forgings, according to size | per ton | From £11 | From £11 | .. |
| f " Scrap, heavy .. .. .. | per ton | 47/6 to 50/- | 47/6 to 50/- | .. |
| f " Wire, galvanised No. 8 .. | per ton | £9 15 | £9 15 | .. |
| g Lead, English Ingot .. .. | per ton | £11 7 6 to £11 10 | £11 7 6 to £11 10 | .. |
| g " " Sheet .. .. | per ton | £13 | £13 | .. |
| m Manganin Wire No. 32 .. .. | per lb. | 8/- | 8/- | .. |
| g Mercury .. .. .. .. | per bot. | £8 15 | £8 15 | .. |
| d Mica (in original cases), small .. | per lb. | 3d. to 9d. | 3d. to 9d. | .. |
| d " " " medium | per lb. | 1/9 to 2/9 | 1/9 to 2/9 | .. |
| d " " " large .. | per lb. | 5/8 to 7/8 | 5/8 to 7/8 | .. |
| p Phosphor Bronze, plain castings | per lb. | 11½d. to 1/2 | 11½d. to 1/2 | .. |
| p " rolled bars & rods | per lb. | 1/- to 1/3 | 1/- to 1/3 | .. |
| p " " strip & sheet | per lb. | From 1/2 | From 1/2 | .. |
| c Platinum .. .. .. .. | per oz. | £4 1 | £4 1 | .. |
| p Silicium Bronze Wire .. .. | per lb. | 9d. to 1/- | 9d. to 1/- | .. |
| i Steel, Magnet, according to desc'p'n | per ton | From £15 to £40 | | .. |
| i " " in bars .. .. | | £58 | £58 | .. |
| g Tin, block .. .. .. .. | per ton | £125 to £127 | £127 to £129 | £2 dec. |
| f " foil .. .. .. .. | per lb. | 1/6 | 1/6 | .. |
| n " wire, Nos. 1 to 16 .. .. | per lb. | 1/6 | 1/7 | 1d. dec. |
| p White Anti-friction Metals — "White Ans" brand .. .. | per ton | £36 to £65 | £35 to £65 | .. |
| f Yarns, 2/10s Grey Cotton, cn sp'n | per lb. | 7d. | 7d. | .. |
| f " 6 lea. Flax .. .. .. | per lb. | 5½d. | 5½d. | .. |
| f " 3 ply 16 lbs. Russian .. | per lb. | 4 1/16d. | 5 1/16d. | .. |
| f " 10 lbs. Russian, single .. | per lb. | 4½d. | 4½d. | .. |
| f " 120 lbs. Jute rove .. .. | per ton | £10 2 6 | £10 2 6 | .. |
| h Zinc, Sh's. (Vieille Montagne brd.) | per ton | £23 | £22 10 | 10s. inc. |

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Co., Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons.
e Messrs. Frederick Smith & Co.

Quotations supplied by
f India-Rubber, G.-P. and Teleg. Works Co., Ltd.
g Messrs. James & Shakspeare.
h Messrs. Edward Till & Co.
i Messrs. Bolling & Lowe.
j Messrs. Walter H. Hindley & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

## CURRENT SPECIFICATIONS.

### CII.—BECKENHAM INCANDESCENT LAMPS.

SUMMARY.

*Extent of Contract.*—Supply during a period of three years of approximately 15,000 incandescent lamps of various candle-powers.
*Candle-Power Specified.*—5-C.P., 8-C.P., 16-C.P., 25-C.P. and 32-C.P.
*Voltage of Supply.*—206 volts.
*Form of Order.*—Lamps to be ordered in lots of 500, and not less than 50 of any particular size.
*Time for Delivery.*—Orders for ordinary types of lamps to be executed within 14 days of order.
*Tests.*—10 per cent. of lamps supplied will be tested at generating station for length of life and efficiency, and if found defective the price paid for same will be adjusted in accordance with formula below.
*Packing and Breakages.*—Contractor to be responsible for all breakages occurring in transit.
*Terms of Payment.*—80 per cent. within one month after conclusion of tests, 20 per cent. at end of following months.

The specification for the supply of these lamps has been prepared by Mr. R. P. Wilson, the consulting electrical engineer to the Urban District Council. The tenders are to be based upon the supply within a period of three years from date of signing the contract of the whole of the glow lamps required, approximately 15,000 of various sizes. The voltage of supply is 206 volts, and schedule prices per 100 are to be given for 5, 8, 16, 25, and 32-C.P. ordinary lamps, and prices per dozen for colouring and frosting lamps, also for flame and silvered lamps. The contractor is to state the results he is prepared to guarantee for each size of lamp as follows:—(*a*) length of life in hours; (*b*) total candle-power-hours, and (*c*) watts per candle-power at maximum, mean and minimum.

The cost per candle-power-hour is also to be given calculated in the following manner:—

$$\frac{\text{(Price per unit (6d.) } \times \text{ total units consumed) + price of lamp in pence.}}{\text{Total candle-power-hours.}}$$

The price to be paid for the lamps as compared with the price quoted shall be reduced by a percentage which shall be the same as that by which the results obtained fall below the guarantee.

All lamps are to be of the screw or bayonet type, suitable for fixing in ordinary holders.

The terms of payment are satisfactory, and it is stipulated that if the tests are carried out within one month of delivery of the various consignments of lamps, it shall be assumed by the contractor that they are satisfactory.

The particulars asked for, and the tests specified, seem on the whole reasonable, though we doubt whether the purchasers will for long continue to make life tests at their own expense, both of lamps and energy upon 10 per cent. of their entire purchase of lamps.

## LONDON COUNTY COUNCIL.

AT last week's meeting of the Council it was decided to lend £28,015 to the Bermondsey Borough Council for electric lighting and refuse destructor purposes, and £8,630 to the Islington Council for electric lighting works.

*Arbitration Clause in Engineering Contracts.*—The General Purposes Committee reminded the meeting of the reference to consider the advisability of modifying the arbitration clause in the Council's contract so that, whilst questions affecting the conduct of the works should remain subject to the sole control and decision of the chief officers of the Council, questions of dispute relating to accounts and claims should be referred to an independent and outside arbitrator, and then only on the termination of the contract. In the opinion of the engineer the proposed modification was desirable, and the Committee remarked that the principle of outside arbitration as regarded matters of account and claims was already recognised in the case of contracts for architectural works. The Committee considered that the principle should be extended to engineering contracts, and they submitted the following clause, which the Council decided to insert in all such contracts in the future:—

Lastly, if at any time before completion of the works any question, dispute or difference shall arise between the Council or the engineer on their behalf and the contractors as to the construction of this contract, or as to any matter or thing arising under or out of this contract, then such question, dispute or difference (unless it relate to matters and things which are under the terms of this contract left to the final decision, requisition, certificate or order of the engineer) shall be referred to the determination of the engineer, whose decision shall be abided by until the completion of the works, when such questions, differences and disputes may as hereinafter provided for be referred to the decision of the arbitrator.

If on the completion of the works there shall remain any question, difference or dispute upon any of the matters or things referred to or specified in the first part of this clause, or as to payments to be made to the contractors, the same shall be referred to the award and decision of or failing him, of some other person to be mutually agreed upon, or failing agreement to some other engineer to be appointed by the President for the time being of the Institution of Civil Engineers, whose decision shall be final and conclusive between the parties. The provisions of Arbitration Act, 1889, shall apply to any arbitration under this clause.

*Underground Telephone Works.*—The report of the Public Control Committee recalled the fact that in 1897 the Council laid down certain conditions which were to be embodied in an agreement with the National Telephone Company with regard to the placing of cables underground. Since then the Council had, on several occasions, given sanction, subject to the company undertaking to abide by those conditions, to works in accordance with plans submitted, but the negotiations with regard to the proposed agreement were not concluded. It was, however, considered that in respect of the works conditionally sanctioned the company should be required to enter into an agreement to comply with the undermentioned conditions in part accordance with undertakings given by the company, compliance with the other of those conditions being waived in relation to these works. The conditions in question were:—

1. That if and whenever the Council or the road authority have power in any way to alter or widen any street or part of a street in which any line of the company is laid, or have power to place any rest, shelter, urinal, or convenience in or under any such street, or part of a street, the Council or road authority may, if they think fit (having given at least one month's previous notice in writing to the company of their intention so to do), require the company to alter any such line, or a portion of such line, or to remove the same to such position as the Council or road authority may require, and thereupon the company shall, with all reasonable despatch, at its own expense, and without any claim for compensation against the said Council or road authority, proceed to alter or remove such line or portion of line as the Council or road authority may require.

2. That, if and whenever the Council desires to adopt electric traction on any tramway belonging to or leased by, or under the control of the Council, which passes along any street or part of a street in which any line of the company is laid, the Council may, if it thinks fit (having given at least one month's previous notice in writing to the company of intention so to do), require the company to alter any such line, or portion of such line, or to remove the same to such position as the Council may require, and thereupon the company shall, with all reasonable despatch, at its own expense, and without any claim for compensation against the Council or its lessees, proceed to make such alteration in the position of such line or portion of line as the Council may require, and so long as no earth return but a complete metallic circuit is provided and used, the Council or its lessees shall not be liable to the company for any interference with, or prejudicial effects produced upon, the cables or wires, or the working of the same, or upon the operations of the company, by reason of such use of electricity upon such tramway.

The Committee proceeded to state that this agreement had never been carried out, owing to the dispute which arose between the company and the Council and the litigation which ensued, but the Council's solicitor had recently inquired whether the company was now willing to enter into such an agreement. The company had, however, replied that it did not see any necessity for a formal agreement, but it stated that it was prepared to adhere to the two conditions in question. As the company was willing to fulfil its undertaking, the Committee recommended the Council to take no further action in the matter. The recommendation was, however, taken back by the chairman of the Committee in order to consider the question of compliance with the other conditions contained in the uncompleted agreement.

*Proposed Company Amalgamation.*—The Highways Committee reported having considered a notice from the Lewisham and District Electric Supply Company of intention to lay high and low tension mains in various streets. These works were disapproved by the Council three months ago, as the company had no generating station within its area of supply, and the Council had no reliable information as to whence the company would obtain a supply of electrical energy. It had now been ascertained that the company intended, in conjunction with the Blackheath and Greenwich Electric Light Company, to apply in the next session for powers which would practically amount to an amalgamation of the two undertakings, so that the mains laid by the first company would be furnished with energy from a generating station belonging to the latter company. In the circumstances, and especially having regard to representations made as to the urgent demand for electric light at Lewisham, the Committee thought that the proposed works might now be approved, subject to special conditions being attached with a view to the protection of the tramways in the thoroughfares specified in the notice in the event of the lines being reconstructed for electric traction. A recommendation to this effect was carried.

*Electric Tramway Schemes.*—The Council adjourned a lengthy report by the Highways Committee relating to new tramway schemes proposed to be promoted in the next Session of Parliament.

## THE PROGRESS OF ELECTRIC SPACE TELEGRAPHY.*

BY G. MARCONI.

(*Continued from Vol.* 50, *page* 1081.)

ANOTHER successful system of tuning or syntonising the apparatus was the outcome of a series of experiments carried out with the discharge of condenser or Leyden jar circuits. I tried by means of associating with the radiating wire or capacity, a condenser circuit which is known to be a persistent oscillator, to set up the required number of oscillations in the radiator. An arrangement consisting of a circuit containing a condenser and a spark gap constitutes a very persistent oscillator. Prof. Lodge has shown us how by placing it near another similar circuit it is possible to demonstrate

* Discourse delivered at the Royal Institution, London, on Friday, June 13th, for a copy of which we are indebted to Marconi's Wireless Telegraph Company, Limited.

interesting effects of resonance by the experiment usually referred to as that of Lodge's syntonic jars.

But, as Lodge points out, "A closed circuit such as this, is a feeble radiator and a feeble absorber, so that it is not adapted for action at a distance." I very much doubt if it would be possible to affect an ordinary receiver at even a few hundred yards.

It is, however, interesting to notice how easy it is to cause the energy contained in the circuit of this arrangement to radiate into space.

It is sufficient to place near one of its sides a straight metal rod or good electrical radiator, the only other condition necessary for long-distance transmission being that the period of oscillation of the wire or rod should be equal to that of the nearly closed circuit. Stronger effects of radiation are obtained if the radiating conductor is partly bent round the circuit containing the condenser (so as to resemble the circuits of a transformer).

My first trials with this system were not successful in consequence of the fact that I had not recognised the necessity of attempting to tune to the same period of electrical oscillation (or octaves), the two electrical circuits of the transmitting arrangement (these

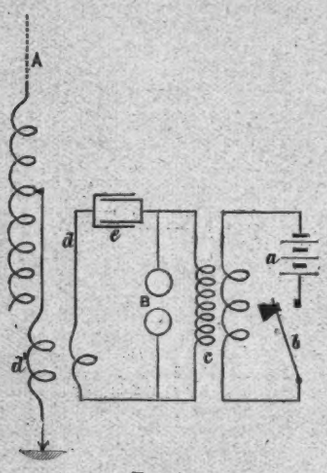



Fig. 1.

circuits being the circuit consisting of the condenser and primary of the transformer, and the aerial or radiating conductor and secondary of the transformer). Unless this condition is fulfilled, the different periods of the two conductors create oscillations of a different frequency and phase in each circuit, with the result that the effects obtained are feeble and unsatisfactory on a tuned receiver. The syntonised transmitter is shown in fig. 1. The period of oscillation of the vertical conductor A can be increased by introducing

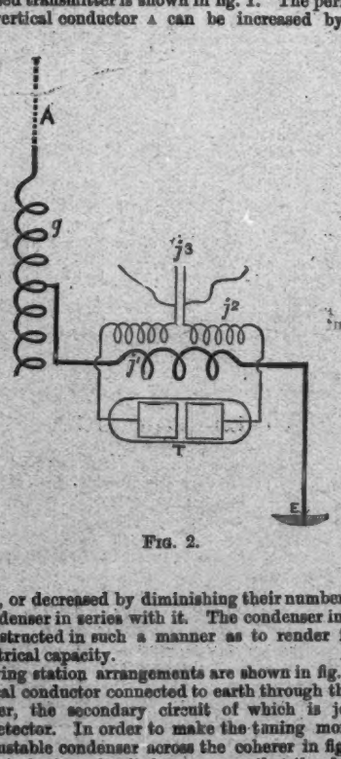



Fig. 2.

turns of wire, or decreased by diminishing their number, or by introducing a condenser in series with it. The condenser in the primary circuit is constructed in such a manner as to render it possible to vary its electrical capacity.

The receiving station arrangements are shown in fig. 2. Here we have a vertical conductor connected to earth through the primary of a transformer, the secondary circuit of which is joined to the coherer or detector. In order to make the tuning more marked, I place an adjustable condenser across the coherer in fig. 3. Now in order to obtain best results it is necessary that the free period of electrical oscillation of the vertical wire primary of transformer and earth connection should be in electrical resonance with the second circuit of the transformer, which includes the condenser. I stated that in order to make the tuning more marked, a condenser is placed across the coherer. This condenser increases the capacity of the secondary resonating circuit of the transformer, and in the case of a large series of comparatively feeble, but properly timed electrical oscillations being received, the effect of the same is summed up, until the E.M.F. at the terminals of the coherer is sufficient to break down its insulation, and cause a signal to be recorded.

In order that the two systems, transmitter and receiver, should be in tune, it is necessary (if we assume the resistance to be very small of negligible) that the product of the capacity and inductance in all four circuits should be equal.

It is easy to understand that if we have several stations, each tuned to a different period of electrical vibration, and of which the corresponding inductance and capacity at the transmitting station are known, it will not be difficult to transmit to any one of them, without danger of the message being picked up by the other stations for which it is not intended. But better than this, we can connect to the same vertical sending wire, through connections of different inductance, several differently tuned transmitters, and to the receiving vertical wire a number of corresponding receivers.

Different messages can be sent by each transmitter connected to the same radiating wire simultaneously, and received equally simultaneously, by the vertical wire connected to differently tuned receivers. This result, which I believe was quite novel at the time, I showed to several friends of mine, including Dr. J. A. Fleming, F.R.S., nearly two years ago. Dr. Fleming made mention of the results he had seen in a letter to the London *Times*, dated October 4th, 1900.

I have further noticed that the tuning can be further improved by the combination of the two systems described. In this case the cylinders are connected to the secondary of the transmitting

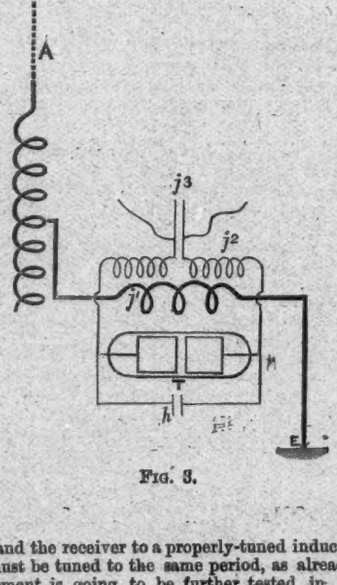



Fig. 3.

transformer and the receiver to a properly-tuned induction coil, and all circuits must be tuned to the same period, as already described. This arrangement is going to be further tested in long-distance experiments shortly to be undertaken between England and Canada.

The syntonic systems have not been applied generally to ships, as it has always been considered an advantage that each ship should be able, especially in case of distress, to call up any other ship or ships which may happen to be at the time within the range of its transmitter, but in the case of land stations the syntonic method has been applied in several instances where necessity demanded it. Thus at the testing stations which maintain communication between St. Catherine's, Isle of Wight, and Poole, in Dorset, when electric waves of a certain frequency are used, no interference whatever can be caused by the working of the Admiralty installations in the vicinity. The long-distance station at Poldhu, Cornwall, is able to transmit signals decipherable on a tuned receiver on a ship at over 1,000 miles' distance, whilst the Lloyd's Wireless Station at the Lizard, only seven miles away, is not affected by the powerful waves radiated from Poldhu if tuned to a different frequency.

I am not at all prepared to say that under no possible circumstances could a wireless message transmitted between syntonic instruments be tapped or interfered with, but I wish to point out that it is now possible to work a considerable number of wireless telegraph stations simultaneously in the vicinity of each other without the messages suffering from any interference. Of course, if a powerful transmitter giving off waves of different frequencies is actuated near one of the receiving stations, it may prevent the reception of messages, but the ordinary systems of communication through wires may be likewise affected.

*(To be continued.)*

## THE ARBITRATION BETWEEN THE METROPOLITAN ELECTRIC SUPPLY COMPANY AND THE MARYLEBONE BOROUGH COUNCIL.

(*Continued from Vol. 50, page 1083.*)

Lieut.-Col. Crompton, cross-examined, said he assumed a much lower price for lighting than Mr. Conacher, which would increase the certainty of getting the load. At present electricity for the purposes of heating and cooking was a luxury, as there was little encouragement for manufacturers so long as they were obliged to use it at 5d. or 6d. a unit.

Re-examined by Mr. Cripps, witness said he believed that by the year 1921 90 per cent. of the people who used artificial light would take it in the form of electricity.

In 1931 what is your idea of the price for lighting and for purposes other than lighting?—The price for lighting in 1931 would be 3½d., and for power 1½d. It was on those prices that he had formed his estimate of custom.

Mr. S. Z. de Ferranti, replying to Mr. Cripps, said he was a member of the Institution of Civil Engineers and a vice-president of the Institution of Electrical Engineers. He had been engaged in electric lighting and other electrical work for 22 years. Since its inception he had been acquainted with the Metropolitan Electric Supply Company. He knew Mr. Gordon, who started it. Considering the largeness of the area to be dealt with, and that it had to be attacked pretty quietly, he thought it was wise for the company to have started as it did with an installation for the high pressure alternating system. He thought it was the general opinion that the alteration the company were now making was the right thing to do considering the amount of the demand and the area to be dealt with. He thought that the large generating station which they were laying down at Willesden was a necessity. He was the pioneer of that doctrine, although at a time when it was too early for commercial purposes. He always looked at it from the point of view of gas, and he thought that internal stations must be a nuisance in a large city, and become more and more so. Now the doctrine seemed to be recognised all the world over that it was best to supply large cities from the outside. He had been over all the plant of the company; some of it was old, and not so good as if put in to-day, but the simple meaning of that was that if it had been more up to date, more money would have been made by it, and the thing would have shown a greater profit. That had been the handicap of the undertaking. The plant had been kept thoroughly well up to date as regarded condition, it was in good working order, and was able to maintain an efficient service. As to the suggested depreciation of the mains of the company, witness said that the condition of the rubber mains was excellent, and he would not like to predict when they would become useless, there was no sign yet. The rest of the mains were manufactured by his firm, and neither in their case did there appear to be the least sign of deterioration or of the mains becoming obsolete; they were of the most permanent character possible. He considered himself that in 1931 those mains would be in no sense commercially inferior to what they were to-day. Regarding the expectations of increased consumers, witness said that at present the progress was rapid and continuous, and they did not in any way appear to have touched the limit. He considered that the estimate of the units to be sold at Marylebone was a maintainable one. As to price, he thought that Colonel Crompton's price was unnecessarily high. He thought the company would be able to sell units both for lighting and power and get a better result than Mr. Conacher arrived at. The whole tendency of the present age was an immense development in the use of electricity for all sorts of purposes, and many sources of demand were sure to arise in the future that were not within our knowledge at the present day. It was hard to set a limit as to what uses electricity would be put to. Every year fresh applications were made for it, and it was quite outside one's knowledge how far it would go. He thought the only thing reasonable within their knowledge was to say that it would not go less than a certain amount, but with regard to figures put in by Col. Crompton, he thought it would be rash to say that electricity would not be sold at more than 50,000,000 units. He certainly thought it would be safe to predict that as the minimum, but it would be very unsafe to predict that it would not exceed that. He agreed with Col. Crompton as to the various uses to which he thought that electricity might be applied. On the question of price, he thought it would pay the company to bring it below the 2d., and that the result would be that the public would get more for their money, and the undertaking would remain of about the same value to the proprietors. He was inclined to think that the load would grow more rapidly than Mr. Conacher estimated in his tables. As to the saving to be effected in expenses, he agreed generally with the evidence that had been given on that point.

Have the company in your view installed as much plant as the areas within Marylebone are capable of holding?—Yes. they have put in plant up to the last kilowatt in their property at Marylebone, and consider that they have put in more plant than was really good for the best economical results—that is to say, the stations are crowded to the last limit. Continuing, witness said he believed that even earlier than 1921, the load factor would go up to 20 per cent. The Charing Cross Company last year had a load factor of rather over 18 per cent. He looked upon Marylebone as it stood at present as quite behind-hand in the way of load factor. As they obtained the demand for purposes other than lighting, the load factor increased, and the taking of small consumers also tended to improve the load factor. It was not the good houses where people were out of town for a portion of the year that were so good for electric lighting. It was thought so at first, but it was the smaller houses that gave the best load factor. That they found in the Portsmouth installation when they had the good customers as they were considered. It was not nearly so valuable as when they got the "slummy" sort of districts; these burned the light for long hours, and greatly improved the undertaking. The tendency had been in Marylebone, with a lot of rich customers, to take them first, especially where they had the individual transformers, and it was costly to connect a new customer; if a small consumer, he was hardly worth putting on. With the new system that did not apply; they could take advantage of the small customers, and that would greatly improve the load factor. He fully considered that the net results estimated by Mr. Conacher would be realised. He thought that the depreciation of 1 per cent. was sufficient. It was not his view that the witnesses had over-estimated the future of the electrical industry in connection with a company of that kind; estimates had generally been wrong on the other side. They had had no idea what the business was going to grow to, and had been surprised at its growth, and he thought with regard to this matter that, whatever the estimate was, the company stood to lose in part ing with such a thing as a public electric supply.

Mr. Conacher, recalled, was re-examined by Mr. Cripps. He repudiated the suggestion that the company had designedly worked its undertaking so as to make Willesden essential to the Corporation of Marylebone. As a matter of fact, the generating plant in the area had been worked to its full capacity, and no plant had been installed outside Marylebone, for which there was room in either of the generating stations there. He had based his estimate as to the probable increase of consumers in the future on the proportion of houses in the district. Colonel Crompton and Mr. Swinburne took a much more optimistic view about the future as far as motor business was concerned than he did, but then he did not know much about the motor industry, as his knowledge of that business was necessarily limited to the experience of the Metropolitan Company. It was a fact that, up to this time, they had rather discouraged than encouraged the use of energy for other than lighting purposes. If they got a larger demand for other than lighting purposes they would get a better load factor. Averaging the profits over the whole period of 42 years on the basis of his calculations, it would give a return of 10·80 per cent. on the share capital. At the end of that period of 42 years, as far as their business was concerned, they would lose it without compensation. The terms of purchase in the Act of 1882 allowed nothing for goodwill or profit. They would get back the then value of the plant, and so on.

Mr. Daniel Watney, a surveyor, said that he had considered the matter of the transfer of the company's works to the Marylebone Borough Council, and had had furnished him by Mr. Conacher the tables which he had put before the tribunal. He had taken the gross earnings at £103,937.

Mr. R. A. Todd, recalled, in reply to Mr. Fletcher Moulton, said he certainly estimated that the supply per consumer would increase in the future.

By Mr. Cripps: Had the water softeners and detartarisers been put in earlier they would have constituted a saving to the company, and would have given a better return as regarded the net revenue. He agreed with Col. Crompton in thinking that in the future the company ought to get a load factor of 20 per cent.

Mr. J. Swinburne was also recalled for cross-examination by Mr. Fletcher Moulton, and, replying to questions, said that in his view a well-managed company would have its prices so low for its own good that it would not pay for competition to start.

Mr. Fletcher Moulton said they would remember the point that was raised with regard to special contracts in mid-London and West London. They had examined the mid-London supply, and had discovered that 80 per cent. of the lighting supply was under special contract. They could not by any possibility have 80 per cent. of exceptions to a rule. He submitted, therefore, that they ought to have full liberty to put those matters before the tribunal, on the ground that the scale in mid-London was represented by what were called special contracts, and not by the printed figure.

Mr. C. A. Russell, K.C., the umpire, said he would like to hear what Mr. Moulton had to say on that point at the end of the evidence of Mr. Swinburne.

Mr. Swinburne's cross-examination was then proceeded with. Witness said he had attempted to prophesy as to what the consumers would number in future years, and had arrived at his conclusions by assuming that a certain percentage of those who were new consumers would be taken on every year. His estimate of the use of electricity was very largely based on the idea that it was going to be largely used for non-lighting purposes. He had assumed the selling price to be the same, although he knew it would go down. His estimate for lighting was 30 millions, and for power 25 millions, but if the price for power was reduced it would go up very largely. The tribunal adjourned.

Mr. Swinburne, re-examined by Mr. Balfour Browne, said that the effect of the Nernst lamp would be to make the light cheaper, which in its turn would tend to largely increase the demand. His experience had been that where lighting was increasing, the demand for energy for power was increasing in a greater ratio. The electric industry started as an electric light industry, and was called by that name even now. The use for motors was subsequent, and he had no doubt that the growth of motors would overtake the lighting. In the future he saw a great number of cases for electrical energy, which it had not been put to up to the present time. The experience of Germany showed that those opportunities for energy existed. There were a great many workshops in Marylebone which would take the energy. With a price of 2d. per unit for motor power, he

certainly thought that the amount he had calculated upon would be taken in the future. He had not gone into the question of the future price for lighting, but at the present price he estimated that 30,000,000 units would be taken. If the price were reduced, the consumption would undoubtedly be larger, but it did not make much difference in the final calculation, for reduction of price meant reduction of profits.

Mr. G. A. Wilkinson, examined by Mr. Cripps, said he had had many years' experience in surveying. Witness then explained the steps he had taken to arrive at the number of years' purchase which ought to be applied to different parts of the company's claim, and said he had arrived at the figure of £2,733,020, which he thought was a fair figure at which to capitalise the interests of the company.

Mr. H. W. Manly, actuary to the Equitable Life Assurance Company, said he had considered from an actuarial point of view, the figures which Mr. Conacher had put in. He accepted the statement made by Mr. Conacher that in 1904, the company would be getting a net revenue of £72,473 in respect of matters which it already had in hand, and he looked upon that as a secured profit. He had taken a 3½ per cent. table in capitalising the £72,473, which gave £1,299,164. The element of future profit he had considered to be subject to contingencies, and although it could be estimated fairly well for some years hence, he thought the estimate for a long period might be considered as perhaps a little problematical. He had therefore calculated the profit for 1905 over the £72,473 at 3½ per cent., and then for each succeeding year he had increased the rate of interest by ¼ per cent. Adopting that system, the aggregate increase of profit came to £640,288. His figures therefore were—as regarded future profits, £640,288; and as regarded profits considered as secured, £1,299,164; making a total of £1,939,452. To that would have to be added the severance and other items with which he had not dealt, as they were not actuarial matters. From his experience as an actuary, assuming that Mr. Conacher's figures were well calculated, he thought that would be a fair way of capitalising their value.

Mr. Robert Hammond, member of the Institution of Civil Engineers, &c., said he had been engaged in electric lighting for about 25 years. During the early part of that time he acted exclusively as a contractor, but for the past 10 years he had acted simply in the capacity of consulting electrical engineer, particularly on behalf of local authorities. The total value of electrical engineering works erected, or in course of erection, under his superintendence amounted to many millions of pounds. He had had an opportunity of watching the development of electric lighting from the beginning. It was true that the alternating high-pressure house-to-house transformer system had undoubtedly great advantages as a pioneer system. It was upon that system that they started the undertakings which had since proved successful at West Brompton. Almost all the work of importance that he had carried out was upon the system which was adopted by the Metropolitan Company, of distributing by high pressure alternating currents and transforming the pressure to low pressure in the houses of the consumers. He had acted for some years as consulting engineer to the City of Sheffield. The same system was put in force there, and also at Leeds, where he laid down the pioneer works in 1892. Since that time in all those places the house-to-house system had been abolished in favour of banked transformers, and low pressure distribution. The capital expense incurred by making that very considerable change had been justified by financial results.

The Umpire said he had not heard it seriously disputed that the change over after a certain point from the house-to-house transformers to the continuous current was a proper and beneficial change.

Sir Edward Clarke remarked that, subject to the question of the cost which it threw upon the persons who carried it out, it seemed to him that that was not a point for controversy.

Mr. Balfour Browne, to the witness: The revenue from the sale of current in 1901 was, in the case of the Metropolitan Company, more than eight times that of its first completed year of work; is that conformable with your experience, and that even greater results might be obtained?—Yes. The increase in the number of units per lamp in the Metropolitan Company from 13·87 in 1893 to 18·60 in 1901, was continued witness, by no means abnormal. They found the same increase going on in other places. The amounts charged by the company during the last four years for meter rents were, in his opinion, reasonable, and he considered that the company might rely upon a continuous source of profit from the rental of meters. In the case of the bulk of consumers there was undoubtedly a tendency to increase the number of lamps. On the question of price, he considered that the charge for motor power at 2d. per unit which was estimated, would be the charge by the Metropolitan Company from 1914 onwards, or a lower one. He had had considerable experience of Germany, and his experience of various towns there, such as Frankfurt, Stuttgart and Strasburg, showed that the amount of energy taken for power purposes was rapidly overtaking the amount used for lighting; his opinion was, that if the power business was pushed in Marylebone the same thing would take place there. He had considered the various uses to which electricity might be applied for power purposes, and he considered that it would not be at all an outside estimate to suppose that 10,000,000 units might be used for traction by the end of 1931. He agreed with Mr. Swinburne that 25,000,000 units was not an excessive amount to look forward to, and that Mr. Conacher in his table had put it at too low an amount.

Cross-examined, Witness said that the hypothesis on which he had based his calculations, was the prices which the company would have had with an area entirely free from competition. He considered that there would be plenty of customers for power from the shops in the district of Marylebone. On the question of competition, with the service the company was giving in Marylebone, he thought it might feel absolutely free from competition. The company had given evidence of its intention to mend its ways by the very great change that it had made in its services; by its Willesden station, and by everything it was doing, it showed that it was meeting the demand. If it was to lower its prices in Marylebone, it would do a very much larger business.

Sir William Preece, replying to Mr. Balfour Browne, said he had had large experience in all questions of electrical energy, and he was consulting engineer to the Metropolitan Company. He had, with the other engineers, considered the tables that had been put in, and agreed with them. He had absolute confidence that the 25 million units would be obtained in Marylebone.

This concluded the case for the company, and after some discussion, the proceedings were adjourned until Monday, August 4th, when Sir Edward Clarke will open the case for the Marylebone Borough Council. If the proceedings are not concluded within a week from that date, they will probably stand adjourned until October.

## ASSOCIATION OF GERMAN ELECTRICAL ENGINEERS.

### How the Home Office Assists Teutonic Companies. The Causes of the Precarious Commercial Position.

The Association of German Electrical Engineers, whose tenth annual meeting has just been held at Dusseldorf, now comprises a membership of 3,133, whilst the circulation of the official journal, *Elektrotechnische Zeitschrift*, reached a total of 7,700 copies weekly at the end of 1901. The report presented by Mr. Gisbert Kapp, the general secretary, stated that during the past year the co-operation of the Association had repeatedly been requisitioned by the German Secretary of State for Home Affairs in connection with the dissemination of information of interest to Teutonic industry. As a rule, the news related to electrical installations projected in other countries, and by this means the German firms had been afforded a convenient opportunity to submit tenders for the work. The firms in question were informed of the contracts by circular, which the Secretary of State placed at the disposal of the Association for this purpose. The report proceeded to observe that the low-tension regulations had been revised, and had been adopted by several of the German States. Regulations for the application of electricity in mining operations had been prepared at the instance of the Breslau Mine Office, whilst the rules governing theatre installations had been revised at the request of the Hamburg police authorities. Both of these regulations had been printed in the official organ, and the meeting gave its approval to them.

Prof. C. Hartmann, of Frankfort-on-the-Maine, in the course of an opening address, stated that the Association was founded in 1893, mainly for the purpose of maintaining those interests concerned with the economic branch, the legislative branch, and the internal organisation of the electrical engineering industry. Considerable anticipations were based upon a policy of common action, from which an amelioration was expected in the condition of severe competition which already prevailed at that time. The principal sphere of activity of the Association from the commencement was placed in the hands of committees, of which the most important was the safety regulations committee which had prepared and frequently revised the rules for heavy installation work. If, on the one hand, the Association could rejoice at the successes achieved from scientific and technical standpoints, it could, on the other, only regret the failures from an economic point of view. The treatment of such questions was first reserved to the Council; an economic committee was then formed, but it was soon dissolved; an economic committee, associated with the Council, also had only a brief existence, and a year ago the Council explained that the Association would only informally deal with economic affairs. During the past few days several firms had established a combination for the preservation of the common economic interests of the German electrical engineering industry. The combination, in view of the urgent necessity for maintaining the foreign markets by the conclusion of long commercial treaties, and also in regard to the anticipated Customs' legislation, would assume a prominent position for the interests of that section of the industry which, in addition to the large and still powerful companies which had not yet joined the organisation, would endeavour to keep up with honour and success the battle of competition in the markets of the world. There were three causes which had helped to bring about the present precarious condition of the industry. The first was the acquisition by manufacturing firms of concessions for the equipment and operation of electricity works. In exceptional cases that might perhaps be accompanied by success, but in principle it was a chimera to give oneself orders in that manner. Secondly, it led to a depression in prices, because the firms underbid themselves in order that their competitors might not have any advantage; and, thirdly, there was a too careless valuation of stocks and insufficient financial provisions, which led to an unpremeditated colouring of the balance-sheets. These evil results showed that the electrical engineer frequently was an inventive constructor and mathematician, but rarely a clever merchant and good accountant. The speaker proceeded to observe that these deficiencies would probably be overcome in the future by the high schools where commercial questions were being taught, as, for instance, at the Leipsic University, the technical school at Aix la Chapelle, Cologne and Frankfort-on-the-Maine.

The meeting proceeded to elect Herr Ulbricht, of Dresden, as president of the Association in the place of Prof. Hartmann, who retired from the chair, and Mannheim was selected as the *locale* for the conference in 1903. Various papers were read and discussed, and the customary festivities and excursions brought the two days' assembly to an end.

## THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

Abstract of Presidential Address by Mr. JOHN H. RIDER, Electrical Engineer, London County Council Tramways, Delivered Wednesday, July 2nd, in London.

It is no small thing to be the President of a body which is now representative of nearly 150 municipalities in the United Kingdom. Taking, as I did, some little part in the formation of the Association, it has been a matter of great personal gratification to me to watch its gradual growth from 1895, when some 25 engineers modestly formed themselves into the Municipal Electrical Association, up to the present, when we number not only about 210 municipal electrical engineers, but also 120 municipalities themselves, among our members.

As the Association grows, its influence is bound to grow with it, but its sphere of usefulness is largely determined by the funds at its disposal. This is a matter about which more will probably be said at the annual business meeting on Saturday next.

At nearly all our previous conventions we have had a paper from a Chairman of Committee, and this year one on "Repayment of Loans" was to have been given. In consequence, however, of the subject having been so fully discussed at our special meeting in February last, it was decided to withdraw it. I hope, notwithstanding this, that the engineering matters which will be brought before you, in the papers which follow, will not prove uninteresting, even to the layman.

One of the subjects with which the municipal electrical engineer of to-day has to deal, and which has developed in this country almost within the life of this Association, is that of electric street tramways. In 1895 there were but five at work, and, with the solitary exception of Blackpool, they were all owned and operated by companies.

At our 1896 Convention I read a paper in which the possibilities of a combined tramway and lighting load were pointed out, and in which attention was drawn to the economies which were likely to result from such an arrangement. To-day there are 36 electric street tramways in operation, which are owned by municipalities, and 16 others in progress of construction. Of the former, 28 are, and of the latter 11 will be, supplied with current from a municipal combined lighting and tramway station. There are also four instances in which the municipal station is supplying current to tramways owned by companies.

These figures bear testimony to the appreciation in which the principles of combination are held by municipal electrical engineers, principles which this association has taken no small part in emphasising from time to time. If evidence be required of the economies to be obtained from a combined lighting and tramway load, we need only turn to a recent issue of the *Electrical Times*. In a list which is there given of those towns holding the record for lowest costs, the seven lowest have combined stations.

Without in any way wishing to draw invidious comparions, I cannot help mentioning two towns, the costs of which are analysed in the issue above mentioned. I will refer to them here as A and B, and I set out, in parallel columns, the figures relating to each:—

| For the year ending March 31st, 1902. | A | B |
|---|---|---|
| Supply started ... ... | October, 1894. | January, 1893. |
| 8-c.p. lamps connected ... | 90,057 | 130,550 |
| Units sold for lighting ... | 1,121,069 | 1,490,099 |
| Units sold for tramways ... | 1,999,640 | — |
| Average price obtained for lighting ... ... ... | 3·41d. | 3·83d. |
| Average price obtained for tramways ... ... | 1·5d. | — |

So far, therefore, as lighting goes, B has a greater lamp connection, a larger output, and a bigger price per unit. But A has a combined lighting and tramway load, while B has a separate tramway station.

Now let us look at the financial results. B has a deficit for the year of £2,763, with a total cost per unit of 2·35d. A has a net surplus of £4,752, and holds the record with a total cost per unit of only ·95d. That these excellent results are largely due to the tramways, I am sure the authorities at A would be the first to admit.

With about three exceptions, the whole of the electric tramways in this country are worked by the trolley system, and it is worthy of note that no company, whose first aim, after all, is to pay a dividend, has adopted any other. The Wolverhampton Corporation is experimenting with a surface contact system, the Bournemouth Corporation is putting down a short length of underground side-slot conduit, as part of a general scheme of overhead traction, and the London County Council has adopted the centre-slot conduit for practically the whole of its lines. The members of this Association are invited to inspect some of this latter construction on Friday next.

The costs of the road construction, for these three distinctive types of electric traction, vary largely according to the local conditions, but are generally somewhat as follows, viz.:—

| | | |
|---|---|---|
| Overhead construction | £5,000 | Per mile of single track, including rails and paving in each case. |
| Surface contact construction | 10,500 | |
| Conduit construction | 13,500 | |

In the face of the very great saving in capital expenditure, which can be made by adopting the overhead system, what are the conditions which would warrant the use of the conduit system? In the first place, in my opinion it is not warranted, unless a car service can be maintained with not greater than a two minutes headway. The capital charges on the road construction are so heavy, that the only way to bring down the cost per car-mile is to increase the number of car-miles as much as possible, by working the lines for all they are worth.

Several corporations have recently been considering the use of the conduit in a similar manner to Bournemouth, viz., for a small portion in the centre of the town, with the overhead system outside. I do not think the conduit is warranted under such circumstances. Certainly the additional cost, for such a short length, may be very small, when compared with the cost of the whole scheme. But is it worth while burdening the undertaking with a combined system, merely for æsthetic considerations?

It may be argued that such combined systems are working satisfactorily in Washington, Paris, Berlin, and other places, and that the change from the conduit to the overhead wire, and *vice versâ*, can be made in a very few seconds. That is quite true, but they mean (1) the constant additional labour of at least one man at each changing place; (2) the carrying of the idle trolley over the conduit section; and (3) either separate machines and feeders for the conduit conductor bars, or the permanent earthing of the negative bar, because of the rail return of the overhead section.

With regard to the carrying of the idle trolley over the conduit section, this is quite an easy matter when single-decked cars are used, as the trolley arm can lie down flat on the car roof, and thus hardly be seen. But, with double-decked cars, there are several practical difficulties, since the arm must be kept out of the way of the passengers.

The use of separate machines and feeders for the conduit section means considerable additional expense, but this cannot be avoided, if the advantages of an insulated negative conductor bar are to be retained.

The abandonment of the overhead for any other system, merely for æsthetic reasons, is, in my opinion, not justifiable. The examples of overhead construction, to be seen in several towns in the United Kingdom, are anything but pretty. Some of them are even ugly. But that is the fault of the designer, and not of the system. It is perfectly easy and practicable to design and erect an overhead line, which shall look well in almost any locality. Neat, and even artistic, work costs very little more than rough and unsightly work.

When, then, are we justified in adopting the conduit system? (1) When the traffic over the lines is so great that the heavy capital charges do not make any serious addition to the costs per car-mile. This is a condition of things only met with in metropolitan cities, and, after all, is no reason why the overhead system should not be used. (2) When the powers for the tramway can only be obtained on the condition that the conduit is used. (3) When the system of lines is so complicated that the overhead construction becomes cumbersome and dangerous. Both (2) and (3) are again controlled by (1), since, unless the traffic can be guaranteed, the line cannot pay, and had, therefore, better not be constructed.

One of the principal difficulties in designing neat overhead construction is that of guard wires. Many an otherwise neat line is entirely spoiled by them. Acting apparently with a view to the safety of the public, but really to protect the telegraph and telephone interests, the Board of Trade has recently issued a new set of regulations, based practically upon those adopted by the Post Office. In order to hear the views of the various tramway authorities upon these regulations, a conference was held a week or two ago, at the offices of the Board of Trade. On the advice of the officials of the Post Office and the National Telephone Company, the Board of Trade refused to allow the principles of guard wire protection to be discussed, and would only permit remarks on the various regulations which were proposed.

As is well known to those with the largest experience in overhead traction work, guard wires may be a protection in some few cases, but in the large majority they are the means of causing the very accidents which they are intended to avoid. Being, of necessity, only small wires, they are a constant trouble to maintain. They are very liable to break when heavy telegraph or telephone wires fall upon them.

A number of automatic devices have recently been placed upon the market, with the object of cutting off the current should any other wire fall across the trolley wire. But neither guard wires nor any of these devices strike at the root of the matter, which is to prohibit entirely uninsulated wires of any kind crossing the trolley wires. If telegraph and telephone wires must be erected overhead, they should only be allowed to cross the streets at right-angles, the spans should be kept exceedingly short, and the wires carried as high up as possible, in order that a broken wire may not reach the street. They should be insulated at such crossings, and, if guards are insisted upon, in addition to the above, they should be provided by a netting or similar arrangement under the telephone wires, and not over the trolley wires.

The recent accidents, which have happened in Liverpool and other towns, have been caused just as much by the telephone wires

as by the trolley wires, but, in the mind of the public, they are called trolley-wire accidents, and nothing else. If local authorities would insist on all telephone wires being placed underground, there would be no necessity for guard wires, or such like unsatisfactory half measures.

Before bringing these somewhat rambling remarks to a conclusion, perhaps I may be permitted to say a few other words, more particularly to our younger engineer members. A visit to a number of electricity works in this country leads one to the conclusion that, in too many cases, plant of too small a size has been put in. By this I do not mean not enough plant, but generating sets for too small an output. Those responsible for the design of the works did not seem to have been very sanguine as to the future of the undertaking, and so they put in sets for as small as 50 KW. output, and in some cases even smaller.

In the course of a few years, when the station has grown, these sets have become too small, and are either never used, or are sold at a loss. Surely if we expect the business of electricity supply ever to approach the extent of gas supply, we should lay out our power stations on generous lines, and put in plant with an idea to its future economical use, rather than to its suitability for just the number of customers we may have for the first year or two. I do not mean that we should put in plant enough to supply the town for the next 10 years. Such a thing is the prerogative of those gentlemen who are paid by commission. But we should select such sizes that they will form a useful part of a well-designed whole, even though they may be apparently much too large for immediate purposes.

The generating stations which we are able to visit, and the systems which we are able to inspect, during our conventions, are great object lessons to us. We can learn not only how to improve our own works, but also, in many cases, what to avoid. No one among us has a monopoly of skill or ideas, and the most able can learn something, even from the beginner. Electrical engineers are too apt to stay at home, to be content with their own plant, and to become even fossilised. In such a progressive science as electrical engineering, we must keep up with the times, or we shall certainly fall behind in the race.

My advice to the municipal electrical engineer is to travel (at the expense of somebody else, if he can) to inspect other people's stations and systems, and to discuss with other engineers the numberless points which arise in everyday work. This association has already done a great deal in affording facilities for this. I know what it has done for me, and I cannot think I am alone in the matter.

## ROYAL SOCIETY CONVERSAZIONE.

At the second Royal Society conversazione on June 18th there were very few new exhibits of physical or electrical apparatus. Some of the apparatus, such as Pidgeon's electrical machine, Mackenzie-Davidson's X-ray exhibits, and Cossor's Braun tube were exhibited at the last conversazione, and have already been described in the Electrical Review.

Prof. Callendar exhibited a simple apparatus for determining the mechanical equivalent of heat. It consisted essentially of a hollow brake-drum filled with a known quantity of water. The rise of temperature produced by the friction between the brake strap and the drum is measured after the expenditure of a known quantity of work in driving the drum. The construction of the brake strap is very ingenious, and appears to be capable of useful application in the ordinary brakes for measuring horse-power. The strap consists of two sections of different materials joined together, and having different coefficients of friction—one half, for example, may be leather, and the other half steel. To the ends of this composite strap weights of different size are connected, and the strap is suspended over the cylinder. When the cylinder is rotated, the strap adjusts itself automatically on the cylinder till the friction on the strap just balances the difference of the weights connected to its ends. The equilibrium is practically independent of the speed, and the weights may be varied within wide limits. The thermal capacity of the apparatus when half full of water is about 500 calories per degree and the temperature may be raised 10° C. in 1,000 revolutions. At this rate of working the external heat loss is a relatively small percentage of the heat generated, and may be accurately measured by making trials with different weights. The rise of temperature is indicated by a platinum thermometer recording automatically on a drum with a scale of 2 cms. to 1° C. With the platinum thermometer it is possible to measure the mechanical equivalent to 1 part in 1,000, if a water jacket is employed to keep the external conditions steady.

Prof. Callendar also exhibited some vacuum jacket calorimeters that had been employed to measure the specific heat of steam. The invention in recent years of the vacuum jacket as a heat insulator has placed in the hands of the modern physicist an instrument which enables him to carry out many experiments which were impossible to his predecessors. When the vacuum jacket is also silvered to stop the passage of radiant heat, we obtain a vessel from which leakage of heat is practically *nil*. Evidently these vessels have great advantages for the construction of calorimeters, as Prof. Callendar has shown in the instruments he exhibited.

A compact and comparatively simple apparatus for liquefying hydrogen was exhibited by Dr. Morris W. Travers. Hydrogen gas under a pressure of 120—150 atmospheres passes through coils which are cooled in solid carbonic acid and alcohol (— 78·5° C.), then in liquid air (— 185° C.), and, finally, in liquid air boiling under low pressure (— 200° C.). The gas then enters a regenerator coil, and, expanding at a valve in the bottom, is partially liquefied. The liquid collects in a vacuum vessel at the bottom of the apparatus; the unliquefied gas passing upward through the regenerator coil cools the gas it contains and returns to the compressor.

Prof. Ramsay made an attempt to reproduce an aurora borealis by exposing an electrodeless discharge in air to the action of a magnetic field. It is a well-known fact that cathode rays tend to follow the paths of magnetic lines of force in their neighbourhood, and it has been supposed that the streamers of the aurora borealis are beams of cathode rays following the lines of the earth's magnetic field which converges them about the poles. Prof. Ramsay has found the spectrum of Krypton in the actual aurora borealis, and also in that which he has artificially reproduced.

Dr. G. Johnstone Stoney exhibited an experiment to show that diffraction spectra are obtained even though the light falling on the grating comes from different parts of the flame. This experiment confirms a theory which he has already published (British Association Report, 1901, p. 570). An image of a gas flame is thrown by a lens on the diffraction grating, so that different parts of the grating are illuminated by light coming from different parts of the flame. When the grating is looked at by a telescope at the proper angle the usual diffraction spectrum is seen, just the same as when the light all comes from one part of the flame. Previously it was supposed that this was impossible, as the light from different parts of the flame might not all be in the same phase.

Another experiment by Dr. Stoney showed diffraction spectra formed by the markings on a diatom. These spectra are seen when looking without an eye-piece down the tube of a microscope on the table of which the diatom is mounted.

Messrs. Edser and Senior showed an optical experiment illustrating a paradoxical consequence of the wave theory of light. Light entering one side of a right-angled prism, which, under ordinary circumstances, would be totally reflected from the hypothenuse side, is found to pass through this surface when a grating is formed upon it. Diffraction spectra are formed of which five or six are visible. Thus light which cannot penetrate the hypothenuse face when it is clear is freely transmitted when parts of the face are rendered opaque.

## THE PARTRIDGE SPARKLET FUSE.

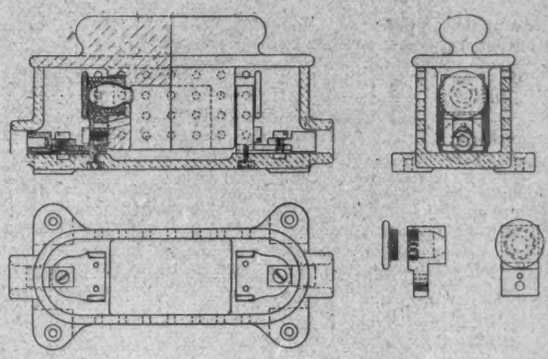
One of the most ingenious devices we have ever met with has been evolved by Mr. G. W. Partridge, chief engineer of the London Electric Supply Corporation, for the rapid extinction of the arc consequent upon the opening of a high pressure circuit under load. Its most notable feature is its extreme simplicity, the essence of the device being the use of an ordinary "sparklet" for the joint purposes of freezing, choking and blowing out the arc.

These sparklets, as our readers are doubtless aware, are small steel bottles, about as large as an olive, containing liquid carbonic acid gas; the necks are closed with thin steel stoppers, made gastight for a pressure of 600 lbs. per sq. in. with a thin rubber ring. Sparklets are commonly used for the purpose of aerating water in "siphons," a simple attachment to the latter enabling the user to pierce

the stopper of the sparklet, so as to release the gas. They are readily obtained in boxes of 12 from chemists, &c., and are inexpensive.

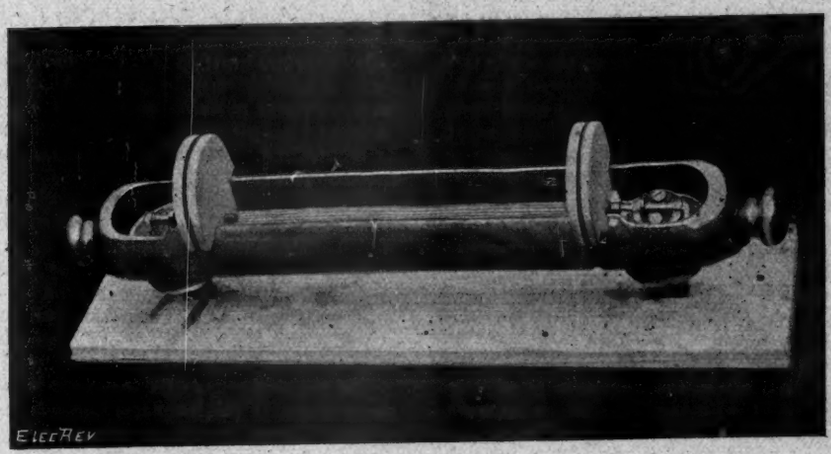
Mr. Partridge, who, by virtue of his position, has had a unique experience of the behaviour of high pressure arcs and fuses, had previously designed and used fuses of the tubular type, 4 ft. 6 in. in length, on the 10,000-volt trunk mains and transformers of the London Electric Supply Corporation; exactly the same type of fuse was adopted by the Metropolitan Electric Supply Company for their Willesden high pressure transmission lines.

Mr. Partridge, however, was not satisfied with these, and, by a happy inspiration, it occurred to him that sparklets were ideally adapted for the extinction of arcs. The sudden expansion of the carbon dioxide, as it flashes into gas, produces a temperature in the neighbourhood of 100° F. below zero; the gas itself, by its incombustible nature, tends to extinguish flame, and, at the same time, the violence with which it is ejected from the sparklet, as though the latter were a small cannon, acts as a mechanical blow-out device of the highest efficiency. A few days ago we had the

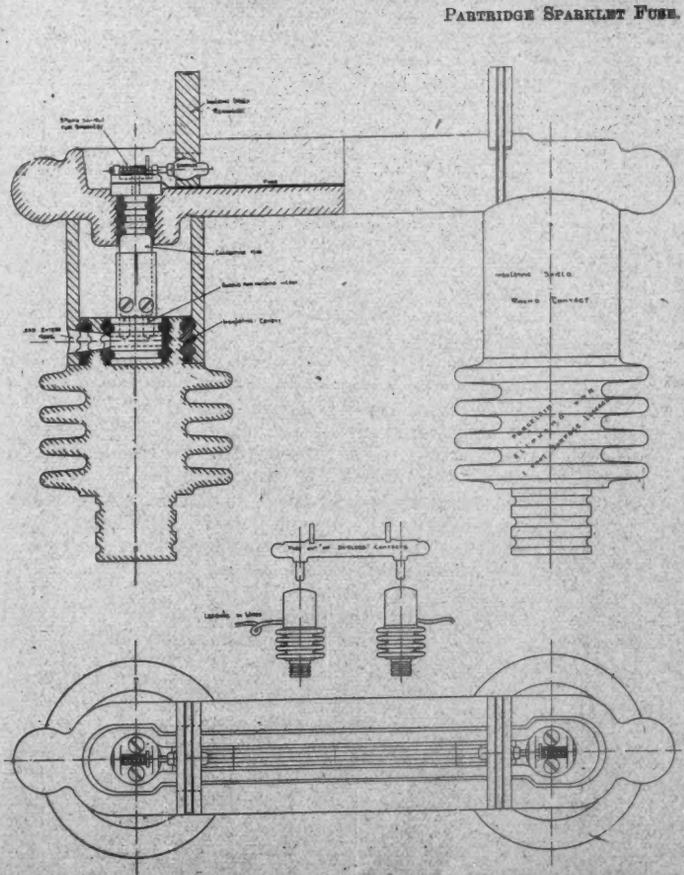


Sparklet Fuse, Type A.

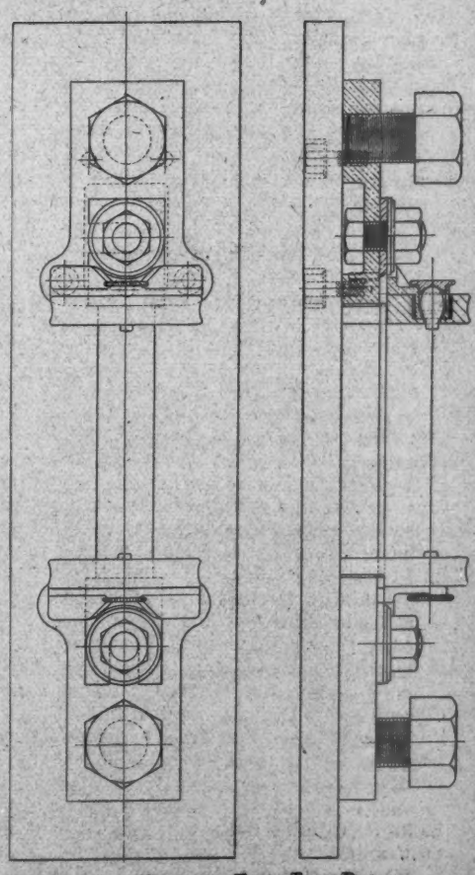
pleasure of witnessing a number of experiments with arcs at a pressure considerably in excess of 10,000 volts, to show the capabilities of the sparklets as arc extinguishers. In every



Partridge Sparklet Fuse.



Partridge Sparklet Fuse, Transformer Type, 10,000 to 20,000 Volts.



Sparklet Fuse, Type D.

instance the arc was put out with certainty and efficiency, even when the gap was but half an inch in length.

The construction of the actual fuses, which have now been in use by the L.E.S. Corporation for two years, is quite simple; the accompanying drawings and photographs will make it clear. The type of fuse illustrated is that which is intended for the high-pressure side of transformers; the body is a trough of earthenware, with a recess at each end, near the terminals. The fuse consists of a suitable number of fine copper wires, which are enclosed between strips of mica for the greater part of their length, but are exposed near the ends. The fuses are made up with metal terminal plates, ready for immediate insertion into the trough. Two marble blocks fit into the recesses in the earthenware referred to above; in each of these there is a hole shaped in such a way as to receive the body of a sparklet, while allowing its neck to project slightly beyond the surface at the side next to the fuse-gap. When these blocks are slipped into place, the sparklets are held in position by spring clamps projecting from the terminals of the fuse, so as to ensure their connection with the circuit—an essential feature. It will readily be understood that directly the fuse has blown, the arc which follows rises, passes on to the end of one or both of the sparklets, fuses the stopper, and presto!—the arc is gone! Nothing more simple or effective could be imagined. The fuse operates equally well whether blown by a short circuit, or by a long-sustained excess of load; the latter condition is regarded by the inventor as an especially severe test, the arc formed under these conditions being peculiarly persistent. The length of gap required to deal with an arc at 10,000 volts is only 9 in., as compared with the 4 ft. 6 in. fuses formerly used; two sparklets are used, one at each end, but this is only for additional security, as one always suffices.

The type of fuse which we have described represents only one out of several designs. The sparklets may be applied to switches which have to operate under heavy loads, and are quite applicable to 500-volt circuits. Mr. Partridge has, in fact, employed them in this way, the sparklet being so placed that the arc formed on opening the switch opens the sparklet. When the system is applied to circuit breakers, a magazine of the revolver type is employed, by means of which a fresh sparklet is brought into position every time the switch is closed. We understand that not one defective sparklet has yet been met with.

Amongst other designs for fuses is one adapted for use on distributing mains in junction boxes. Drawings are also given herewith of two other types of fuse. The fuses may be seen in operation at the Tramways Exhibition, at the stand of Messrs. Elliott Bros., Limited, who have secured the right of manufacture and sale for this country.

## THE INSTITUTION AND THE BOARD OF TRADE.

[COMMUNICATED.]

The interview with the President of the Board of Trade on 18th ult. marks the close of the first act in the procedure of the Institution towards relieving the electrical industry from the restrictions imposed upon it by legislation. So far as the Government is concerned, there is not much hope of any immediate action being taken, and it is doubtful if they fully realise the position.

The principal organs of the Government in the press admit the importance of the case put forward by the Institution, but recognise the fact, in not very complimentary terms, that not much is to be expected from the Government.

The *Times* says that Mr. Gerald Balfour was "too much concerned to point out, in the apathetic official manner, that the obstacles to electrical development are not entirely legislative, but spring from the multiplicity and complexity of existing interests;" and then, forcibly reminds the Government, that "it is the business of wise legislators to devise means for reconciling these interests with the new needs of modern life."

The *Globe* is more severe when it taxes the President of the Board of Trade with "complacent inability to grasp the importance of the subject," which it graphically describes as a throttled industry.

It is evidently true that neither the public nor its rulers have grasped the economic significance of our backwardness, and we may add the enormous importance of promoting the industry as a means of solving the pressing problems of industrial redistribution as the only means of relieving the congestion in our overcrowded centres of population.

The only grains of comfort offered by Mr. Gerald Balfour are the promise, at some uncertain distant date, of two Bills dealing with electric traction and electric supply, but there is only a vague intimation of the character of these measures in the significant sentence: "I trust that that measure, when introduced, will prove satisfactory to both parties, both to promoters and local authorities."

It will be interesting, after the promised Government legislative feast, to see the lions and the lambs gambolling sportively together, while the American and German manufacturers look on with complacency, and continue to watch the skill with which the old country throttles an industry.

A remark of Mr. Balfour's indicated the extraordinary confusion of his mind when he said: "It appears to me, however, after listening to the various speakers, that the really important question is not so much that of any impediments thrown directly by the Legislature in the way of the development of the industry, as of the power which the Legislature has given the local authorities to veto schemes." Exactly so, and this is the legislative impediment for which a remedy is required.

The fact is, that the industry is sacrificed to the fear of losing the political support of the local authorities, which Mr. Balfour admitted was "a very great power in this country," and in its effect upon any efforts at legislative reform, he reminded the deputation of "the difficulties which stand in the way so long as local authorities take so strong a view of the powers which ought to be reserved to them in connection with these enterprises."

The practical remedy for this state of things is to alter the character of the Municipal Councils, and this can only be accomplished through the ratepayers.

Mr. Swinburne assured the President that the Institution did not go to see him as opponents of municipal trading, and probably a large proportion of the members of that body who look to the local authorities for their business, are by no means opposed to the socialistic principles which are being so industriously introduced into municipal action.

We question if by coquetting with this pernicious interference with legitimate business, the career of the electrical engineers embarked in it will be improved; there is already a tendency on the part of the best men to gradually leave the ranks of the municipalities, the best positions and encouragement and permanent appointments being found in enterprising private companies where the progressive engineer is associated with the best class of managers, and may be free from the control and interference of committees absolutely unfit for conducting such a business.

The end will be a residue of case-hardened municipal servants of the caliber of the average municipal surveyor earning the same poor remuneration.

Mr. Swinburne, while not opposing municipal trading, wisely urged that the effect of it upon the electrical industry should be investigated so that his Majesty's Government might know whether it was a good thing, not for municipalities considered alone, but for the community at large, having regard to questions of engineering, local indebtedness, housing, rapid transit, and concentration in cities; and he urged that this could best be done by a Royal Commission to consider the whole question of electrical legislation. He might have also suggested the immediate re-appointment of the Select Committee on Municipal Trading, if Mr. Balfour could not recommend his colleagues to appoint a Royal Commission.

The public want enlightening upon the important position of general trading interests in connection with municipal monopolies. The *Times* calls for the real, practical and scientific interest of the country to aid the politicians and their official experts, and speaks plainly of the "Boards of Trade, with their self-sufficiency, their timidity and their necessary ignorance of the later phases of development that

other nations have adapted their legislation to the progress of science."

While public opinion is being formed by the action of Associations like the Industrial Freedoms League, with the organisation of branches in every municipality, the Board of Trade can materially assist by exercising the powers they already possess of ascertaining by local inquiries the sentiments of the ratepayers before granting provisional orders to any local authority.

The Board of Trade may say that this would involve an amount of work for which their staff was inadequate, but this can easily be remedied, and is absolutely necessary if the ratepayers as a body and not the small number forming the Councils are to decide the question.

If this course were followed the need for legislative reform in this matter would be less urgent, as it is evident from the experience of the last few months that when the ratepayers have been appealed to they almost invariably decide against municipal trading in the supply of electricity.

Apart from the main question of whether such trading is or is not in the interest of the community, it is irrational and grotesque for even a municipal trader to object to the removal of all shackles that tend to the restriction of trade, for it is quite clear that even from his point of view it cannot interfere with healthy municipal enterprise, nor check it in any way, if industries are free from unwise legislative interference.

The Institution has made an important move forward, and if success is to attend its first effort, it must persevere enthusiastically until it ultimately triumphs over the powerful obstacles in the path of the industry, the best interests of which it is its duty to promote.

## NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

### NEW PATENTS, 1902.

**Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.**

13,047. "Electrical hot air and vapour baths." W. Waddington and W. Wainhouse. June 9th.

13,064. "An improved electrical fire alarm." R. W. Cooke and J. Scott. June 9th.

13,074. "A patent automatic electric heating apparatus for governing incubators." F. Tomlin. June 9th.

13,082. "An improved combined electrical switch and cut-out for street poles and the like." M. Railing and J. H. Collings. June 9th.

13,088. "Improvements in electric arc lamps." R. Hoffelt. June 9th.

13,115. "Improvements in wireless telegraphy." J. H. Thomson. June 9th.

13,119. "Improvements relating to electrical testing apparatus." D. Perret. June 9th.

13,154. "Improvements in and connected with electro-magnetic annunciators for telephonic or similar purposes." H. Oppenheimer. (Action-Gesellschaft Mix and Genest, Germany.) June 10th.

13,164. "Improvements in regulating electric light circuits especially applicable for the lighting of trains." H. Leitner and R. N. Lucas. June 10th.

13,170. "Trolley wire support." E. Hill and E. Hill, Jun. June 10th. (Complete.)

13,171. "Trolley wire support." E. Hill and E. Hill, Jun. June 10th. (Complete.)

13,175. "Improvements in equalising appliances for inter-connected polyphase current systems." Siemens Bros. & Co. (Siemens & Halske Aktien-Gesellschaft, Germany.) June 10th. (Complete.)

13,181. "Improvements in the current collectors or trolleys of electric railways and tramcars." J. Wetter. (P. Pfeiffer, Germany.) June 10th.

13,205. "Improvements in or relating to electric clocks or time-pieces." J. Buhler. June 10th. (Complete.)

13,267. "Improvements in and in connection with fusible electric cut-outs." W. P. Burke. June 11th.

13,275. "Improved safety device for electric railways." E. Parry and F. W. Bidder. June 11th.

13,297. "An improved trolley head, arms and posts for overhead electric wires, and a safety appliance for rendering broken electric wires harmless." J. J. Carter. June 12th.

13,357. "Improvements in connection with trolleys for electric tramways or railways." The British Thomson-Houston Company, Limited, and F. Samuelson. June 12th.

13,426. "Improvements in electric railway systems. H. H. Lake. (T. E. Murray and J. van Vleck, United States.) June 13th. (Complete.)

13,491. "Inter-communication switch for telephones." H. R. Webb. June 14th.

13,500. "An improved apparatus for commuting electric current, particularly applicable for combined arc and incandescent electrical lamp circuits." C. E. and H. M. Peel, Limited. June 14th.

13,526. "Improvements in means for electrically operating countershafts." The British Thomson-Houston Company, Limited. (N. C. Bassett, United States.) June 14th.

13,527. "Improvements in electrical measuring instruments." The British Thomson-Houston Company, Limited. (L. T. Robinson, United States.) June 14th.

13,528. "Improvements in inertia dampers for electric measuring instruments." The British Thomson-Houston Company, Limited. (W. H. Pratt, United States.) June 14th.

13,529. "Improvements in electric starting rheostats." The British Thomson-Houston Company, Limited. (C. E. Harthan, United States.) June 14th.

13,530. "Improvements in brush-holders for dynamo-electric machines." The British Thomson-Houston Company, Limited. (N. C. Bassett, United States.) June 14th.

13,531. "Improvements in electric snap switches." The British Thomson-Houston Company, Limited. (H. Geisenhoner, United States.) June 14th.

13,532. "Improvements in connection with electric condensers." The British Thomson-Houston Company, Limited. (W. S. Moody, United States.) June 14th.

13,533. "Improvements in armature bands for dynamo-electric machines." The British Thomson-Houston Company, Limited. (J. J. Wood, United States.) June 14th.

13,534. "Improvements in electrical motor control sytems." The British Thomson-Houston Company, Limited. (C. E. Barry, United States.) June 14th.

13,536. "Improvements in means for the control of the supply of electricity to electric motors for hauling plant, and similar apparatus in which the demand for energy is intermittent." C. Ilgner. June 14th. (Complete.)

13,594. "Improvements in electric commutators." C. H. Prött. June 16th. (Complete.)

13,604. "Electric incandescent lamp." G. Bellina. June 16th.

13,612. "Improvements in and relating to electric fire alarms." H. Hawthorn. June 16th.

13,626. "Improved manufacture of hydroxylamine and chlorine by electrolysis." O. Imray. (Farbwerke vormals Meister, Lucius & Bruning.) June 16th.

13,658. "Improvements in and relating to electric switches." W. Sevenoaks. June 16th.

13,727. "Improvements in electric snap switches." The British Thomson-Houston Company, Limited. (F. L. Fenn, United States.) June 17th.

13,728. "Improvements in electric push-button switches." The British Thomson-Houston Company, Limited. (E. G. Kastenhuber, United States.) June 17th.

13,729. "Improvements in trip coils for electric circuit breakers." The British Thomson-Houston Company, Limited. (J. D. Hilliard, jun., United States.) June 17th.

13,731. "Improvements in globe holders for electric arc and other lamps." The British Thomson-Houston Company, Limited. (J. J. Wood, United States.) June 17th.

13,732. "Improvements in electric arc lamps." The British Thomson Houston Company, Limited. (C. E. Harthan, United States.) June 17th.

13,734. "Improvements in electric transformers." The British Thomson-Houston Company, Limited. (W. S. Moody, United States.) June 17th.

13,737. "Improvements relating to systems for electrical distribution." H. H. Lake. (General Electric Company, United States.) June 17th.

13,738. "Improvements in electric hoisting apparatus." H. H. Lake. (General Electric Company, United States.) June 17th.

13,739. "Improvements in and relating to insulating material." H. H. Lake. (General Electric Company, United States.) June 17th.

13,740. "Improvements relating to electric traction." H. H. Lake. (General Electric Company, United States.) June 17th.

13,741. "Improvements in and relating to electric switches." H. H. Lake. (General Electric Company, United States.) June 17th.

13,742. "Improvements in systems of electrical distribution." H. H. Lake. (General Electric Company, United States.) June 17th.

13,743. "Improvements in motor controlling devices." H. H. Lake. (General Electric Company, United States.) June 17th.

13,789. "An improved connecting rod for connecting telephones and telegraphic instruments to overhead conductors." C. Dietz. June 17th.

13,792. "A new or improved fault indicator for electric circuits." M. B. Field. June 18th.

13,797. "Improvements in connection with enclosed spring swivelling trolley standards and trolley heads for electric locomotives, cars, or trucks." T. E. R. Phillips and F. A. M. Allingham. June 18th.

13,802. "A speed indicator for electric tramcars, trains, and locomotives." J. R. Crisp and J. F. Moore." June 18th.

13,851. "Improvements in electric motor controllers." The British Thomson-Houston Company, Limited. (J. B Sinn, United States.) June 18th.

13,852. "Improvements in electric switches, or circuit breakers." The British Thomson-Houston Company, Limited. (R. H. Read, United States.) June 18th.

13,853. "Improvements in electric switches." The British Thomson-Houston Company, Limited. (E. M. Hewlett and T. E. Button, United States.) June 18th.

13,854. "Improvements in electric switches worked by electro-magnets or solenoids." Siemens Bros. & Co., Limited, L. M. G. Ferreira, and R. Wilkie. June 18th. (Complete.)

13,856. "An electric light carrier ring adjuster and ring." J. W. Kirk. June 18th.

13,857. "Improvements in or relating to electric railways, &c." A. J. Boult. (L. Negro, Italy.) June 18th.

13,933. "Improvements in variable speed direct current shunt motors." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) June 19th.

13,934. "Improvements in electric current transformers for high voltage circuits." The British Thomson-Houston Company, Limited. (A. R. Everest, United States.) June 19th.

13,956. "Improved thermo-electric indicator." L. W. Winship. (The Firm A. Heinz et Cie., Belgium.) June 19th. (Complete.)

14,129. "Improvements in or relating to printing by electricity in colours." W. Friese-Greene. June 21st.

14,133. "Improvements in connecting carbon electrodes with electric leads." H. Baker and The Castner-Kellner Alkali Company, Limited. June 21st.

14,134. "Improvements in and connected with carbon electrodes." A. T. Smith, H. Baker, and The Castner-Kellner Alkali Company, Limited. June 21st.

14,135. "Improvements in electrolytic cells." H. Baker, A. T. Smith, and The Castner-Kellner Alkali Company, Limited. June 21st.

14,136. "Improvements in telephones for diving and like purposes." W. A. Gorman and A. Graham. June 21st. (Complete.)

14,139. "Improvements relating to apparatus for controlling electric motors." H. H. Lake. June 21st.

14,139. "Improvements relating to apparatus for regulating electric currents." H. H. Lake. (General Electric Company, U.S.A.) June 21st.

14,140. "Improvements in electrical indicators." H. H. Lake. (General Electric Company, U.S.A.) June 21st.

14,141. "Improvements in or relating to electric switches and motor starting devices." H. H. Lake. (General Electric Company, U.S.A.) June 21st.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

### 1900.

**7,410. "Improvements in regulators for electric arc lamps." P. Kashauer, M Haberleitner and O. Leeck.** Dated April 21st, 1900. A clutch consists of two or more hollow jaws of smaller bore in their upper portions, and held together by a ring. Their ends are pivoted to arms of the movable tubular core of a series solenoid. The upper carbon passes through an insulated guide below the clutch, and is inserted in a heavy socket provided with friction springs and sliding in a guide tube. 2 claims.

**7,471. "Improvements in electric telegraphy." S. G. Brown.** Dated April 23rd, 1900. Relates to arrangements and systems of duplex telegraphy capable of being duplexed and thus converted to quadruplex. 8 claims.

**7 562. "Improvements in third-rail insulators for electric railways." E. W. Rice.** Dated April 24th, 1900. Relates to electric railways and tramways with third-rail conductors. To allow the third rail some vertical play, a square or other section tube D moulded in the insulating material, slides on the stem of support. A rubber cushion or the like may be placed in the cap. The rail may be secured between two lugs on turning the cap which is screwed internally. 8 claims.

**7,567. "Improvements in electric bonds for connecting the meeting ends of two contiguous electric conductors." H. P. Brown.** Dated April 24th, 1900. The bonds comprise a metallic plate held to the ends of the conductor or rails so that they may move relatively to it, an intermediate stratum or mass of metallic lubricant or plastic alloy, adhering to both plate and conductor, being inserted. 3 claims.

**7,606. "Improvements in electric controlling switches." C. H. Lindstrom and J. Hewitt and T. Hewitt.** Dated April 24th, 1900. Controllers for automobiles, especially for use with secondary batteries. 7 claims.

**7,608. "Improvements connected with the production of electric light." E. Rasch.** Dated April 24th, 1900. Electrodes are made of refractory oxides, conducting only after preliminary heating by a flame, a resistance or otherwise, or passage of spark discharges. The electrodes may also be made of materials conducting, somewhat at ordinary temperatures, such as oxides of chromium, iron, copper, uranium, manganese, nickel, cobalt, titanium, zinc, tungsten, and molybdenum. The arc can be started between such electrodes by applying high electric pressures. 6 claims.

**7,667. "Improvements in and connected with cord grips for electric lamp holders, ceiling holders, and the like." W. T. Burbey.** Dated April 25th, 1900. A cord grip for a flexible conductor is prevented from turning in a lampholder, a ceiling rose, or the like by serrating the opening in which the cord grip is placed, or by forming or securing a projection in the holder, &c., to engage a longitudinal groove in the cord grip; the cord grip is held by a screw cap. 3 claims.

**7,675. "Improvements in electrical time distributing apparatus." H. H. Lake.** Dated April 25th, 1900. Relates to apparatus for transmitting regular movement from a main clock, capable of supplying comparatively great power by means of polyphase electric currents, to one or more synchronous sympathetic devices intended to move the hands of a clock, the axis of certain astronomical instruments, &c. 1 claim.

**7,678. "An improved automatic letter-writing telegraph." A. Pollak, J. Virag, J. Lugar and F. Silberstein.** Dated April 26th, 1900. Relates to a system of telegraphy in which perforated code signals are automatically transmitted and reproduced at the receiving station in the form of written characters. The apparatus described for use when an alphabet of forward or open loops only is employed, or when the alphabet includes backward or closed loops; in the latter case, the code signals are divided between two lines so as to produce two motions, preferably at right angles, at the receiving station. This form is described with two separate circuits, and also with the second circuit superimposed on the two arms of the first circuit arranged in parallel by means of inductance coils. 7 claims.

**7,691. "Improvements in electrical work measuring instruments." G. W. Johnson. (Hartmann & Braun, Germany.)** Dated April 25th, 1900. Induction motor meters and electro-dynamometers are arranged for use on balanced three-phase alternating systems. 1 claim.

**7,695. "Improvements in wall plugs for electric lighting and heating." S. S. Galsworthy.** Dated April 26th, 1900. A wall plug is formed of a solid mass of porcelain or the like, having holes for the reception of the pins and screws for securing the cap. The pins have square heads, so that they cannot turn, and are secured by nuts. The block is grooved and fitted with projections to serve as a grip for the wires. The plug may be recessed to engage a projection on the socket, or the plug may be fitted with a projection to fit in the socket. 4 claims.

**7,737. "Improvements in and relating to arc lamps." A. Tribotherro.** Dated April 26th, 1900. An escapement regulating lamp is constructed in which the lower carbon is carried in a frame of vertical rods, on which are links and a spring supporting a round rod in an inclined position. The upper carbon is carried by a core supported above a shunt solenoid by a spring. The solenoid is supported by a carriage, movable vertically in a frame, and having a grooved wheel bearing on an inclined rod and geared to a star-wheel. Normally rotation of the star-wheel is prevented by an arm of the core, so that descent of the carriage is prevented, the star-wheel being released only when the action of the shunt solenoid lowers the core sufficiently in the carriage. The solenoid may otherwise be wound differentially, and arranged to raise the core so that its arm engages the star-wheel. The inclined rod and grooved wheel may be replaced by a vertical rack and a pinion. 2 claims.

**7,758. "Improvements in trucks for auto cars." A. Mukiberg.** Dated April 26th, 1900. Relates to a truck or under-carriage constructed so as to be flexible in all directions, in order to prevent or reduce shocks arising from irregularities in the road. 4 claims.

**7,774. "Improvements in wire connectors." A. Gartner and C. Mointire.** Dated April 26th, 1900. Wires are connected by means of a metal tube or sleeve, in which an indentation or indentations are formed, and by twisting such sleeve. 6 claims.

**7,768. "An improved negative accumulator electrode." E. W. Jugner.** Dated April 26th, 1900. Relates to the production of a negative electrode, especially adapted for use in the accumulator described in Specification No. 7,892, A.D. 1899. The electrode consists of wire net or perforated plate, on which is spread a basic salt formed by the union of cadmium oxide with other substances, such as cadmium chloride, cupric chloride, or ammonium chloride. The mixture sets into a cement-like mass. Iron, manganese, copper, or combinations of them may be added to the cadmium oxide. 2 claims.

**7,777. "Improvements in apparatus for wireless telegraphy. G. Marconi.** Dated April 26th, 1900. Relates to improvements in the arrangements of wireless telegraphy described in Specifications No. 12,039, A.D. 1896; No. 12,326, A.D. 1898; and Nos. 6,982 and 25,186, A.D. 1899. The secondary of the induction coil is connected through one or more condensers to the primary of a transformer, the secondary of which is connected to earth or a capacity, and with an adjustable inductance connected to the aerial conductor. In the receiving apparatus, the aerial conductor is connected through a similar inductance to the primary of an induction coil, with which a condenser is arranged in parallel. The secondary is divided by a condenser, and has its terminals connected to inductances. The inductances are connected through the coherer and a condenser in parallel. The local circuit, including impendances, is connected to the terminals of the condenser. Several forms of transformer and induction coil are described for use with the transmitter and receiver respectively. The transformer is wound preferably on a rectangular frame, the secondary being divided and lying on each side of the primary. A cylindrical transformer having equal turns in each coil, may also be employed, or one in which the layers of the secondary decrease in numbers outwardly. Several arrangements of induction coils are described in which the secondary is centrally divided by a condenser. The primary may be single, divided, or in parallel coils. The secondary may be wound in a single layer inside, or outside the primary, or may be in several layers decreasing outwardly in number. 2 claims.

**7,784. "Improved system of distributing and collection of current for electric traction." G. Davis.** Dated April 27th, 1900. Relates to electric railways and tramways, &c., with overhead supply and return conductors. A frame with trolley wheels running on one conductor is provided with arms, carrying rollers to run on the outer conductor. The arms are attached in the upper or lower position, according to the direction of travel, so that the out-going ones, for instance, ride over those which are returning, and a bridge piece with downwardly curved ends is attached to each frame, so that the rollers can run over it and not lose contact. The ends may be hinged so as to follow curves. In the form shown, the arms are hinged, but they may be fixed in sockets on the frames, insulation being provided between the supply and return current collectors. An upper second guide parallel to the bridge may be discharged in a direction either perpendicular to that of the furnace gases or making an angle of less than 90° with it. 6 claims.

**7,792. "Improvements in electrically-operated brakes for centrifugal drying machines or hydro-extractors." H. C. Longsdon and S. Dale.** Dated April 27th, 1900. Relates to brakes for electrically-driven and other hydro-extractors. A disc, prevented from rotating in a casing is pressed down by a spring against a disc fixed on the upper end of the machine spindle. An electromagnet is mounted above the disc, and this is energised when the machine is started and draws the disc out of contact. 2 claims.

**7,795. "Improvements in electric light fittings." H. W. Calderbank.** Dated April 27th, 1900. A ball fitting, applicable to carry several lamps or an arc lamp, or as a ceiling connection, or part of an electrolier, is made in halves, which are connected mechanically by bayonet slots and pins, or a screw coupling ring or set screws, and electrically by spring plungers and contact plates carried in separate recesses in insulators. The parts can thus be separated and put together without disturbing the connecting wires, which pass separately through holes in the insulators to binding screws on the metal parts. The middle partitions of the insulators fit together when the fitting is united. 1 claim.

**7,861. "Improvements in and connected with electric incandescent lamps." O. Riebensahm.** Dated April 27th, 1900. A bulb is made with a neck contracted and tapered at the end, and with an internally projecting tube. The leading-in wires are sealed in the inner end of the tube. One wire is bent over and coiled on the contracted part of the neck. The other wire is secured in an insulating plug placed in the tube. A screw or other cap has a metal part, containing a metal liner, which is formed into tongues to bear on the coiled wire, when the neck is pushed into the cap; an insulating part of the cap carries a central contact and a spring with a piece to bear on the wire. 5 claims.

**7,861. "Improvements in or relating to electrical reciprocating apparatus." J. Brown.** Dated April 27th, 1900. Relates to electrical reciprocating apparatus, which, in the smaller form, may be used for beating eggs, chopping meat, &c., and in the larger form, for rock drilling, pumping, &c. The instrument by which the work is performed (*e.g.*, a knife, egg beater, hammer, saw, or rock drill), is carried by the movable core of a solenoid, the winding of which is connected with electrical contacts, which are made and broken by the movements of the core. 10 claims.

**7,916. "Improvements in actuating semaphore and like railway signals." W. Smith and G. Smith.** Dated April 28th, 1900. Relates to semaphore, &c., signals, controlling and locking signals, interlocking wire and rod compensators. 6 claims.

**7,983. "Improvements in electrical signalling." J. N. Maskelyne.** Dated April 30th, 1900. Relates to wireless signalling by Herizian radiations, and includes means for exciting and detecting the radiations, and for applying the transmitted impulses for general purposes of signalling or telegraphy or for actuating a Morse sounder or recorder, or a printing telegraph. In the transmitter the radiations are produced in an elevated conductor forming part of the secondary circuit of the induction coil, which circuit is broken at a spark-gap, and may include an earth connection. 9 claims.

**7,989. "Improvements in electric switches." W. Jones.** Dated April 30th, 1900. Relates to switches for use in connection with street traction, &c. The contact blade is made in two sections separated by distant pieces or by washers and pivoted. The handle or arm is adapted to be forced between the side pieces to make good contact with the fixed contact. The arm is connected to the side pieces by springs to give a quick break, and is formed with a heel-piece to engage a pin and give a positive start. 3 claims.

**7,999. "A new and improved controlling apparatus for passenger lifts." O. Kammerer.** Dated April 30th, 1900. Relates to electric lifts. 2 claims.

**8,051. "Improvements in or relating to propelling and steering devices for motor road vehicles." A. Boult.** Dated May 1st, 1900. Relates to propelling and steering devices for electrically-driven motor vehicles. 15 claims.

**8,061. "Lightning conductors and arresters for overhead electric conductors." J. H. Poche.** Dated May 1st, 1900. Relates to means for protecting overhead conductors from the effects of lightning. The protector consists of a metal tube, in the centre of which is fixed an insulator for supporting the conductor. The tube is provided with discharge points and an elevated portion. The tube may be mounted singly or in groups held in metal rings on metal or wooden posts; in the latter case the metal portions are connected to earth. Discharge points may be attached to the insulated support, or the ends of the tube may be closed by discs. Pointed discharge bosses may also be clamped on the conductors. 2 claims.

**8,067. "Improvements in harmonic telegraphy." A. T. M. Johnson.** Dated May 1st, 1900. Relates to harmonic telegraphs in which any one of a number of receiving stations can be selected by a transmitting station by means of a series of double reeds. 5 claims.

**8,111. "Improvements in parts of telephone instruments." B. Brandar and British Electric Works.** Dated May 2nd, 1900. Table or wall apparatus is arranged with the magneto-magnets forming a frame which is closed in by plates to receive the induction coil, polarised bell, and the switching appliances. The motor is driven by a spur wheel, which gears with an internally-toothed wheel. 8 claims.

**8,123. "Improvements in and connected with electric light wall plugs." H. Oppenheimer.** Dated May 2nd, 1900. A wall plug is formed with a base of china, or the like, having two lateral recesses, which are each met by two descending openings. In each recess is fitted a terminal piece, drilled and fitted with a screw to fix the line wire, and also drilled to receive the socket. In a modified form the line wire is led through a hole in the base. 1 claim.

**8,152. "Improvements in electric transformers." W. L. Wise.** Dated May 2nd, 1900. In order to minimise eddy currents in three-phase transformers having three cores, the yokes are so constructed that the sheets are parallel to the sheets forming the cores. The yoke is bent at the edges so that when placed in position above and below the cores the edges meet and the centre parts are parallel to the sheets of the core. The yokes are clamped in suitable castings, and the end plates are bolted together. A switchboard is provided, access being obtained through a door in the casing. 3 claims.

**8,160. "Improvements in electric switches." W. Ely.** Dated May 2nd, 1900. Switches adapted to be quickly thrown over to break one circuit, or set of circuits, and make another. 3 claims.

**8,175. "Improvements in electric switch apparatus." W. T. Jones.** Dated May 3rd, 1900. Relates to means for giving a quick step-by-step movement in switches having a series of contacts, such as in motor-starting switches. 2 claims.

**8,227. "Improvements in or connected with windings for dynamo-electric generators, motors and converters." V. A. Fynn.** Dated May 3rd, 1900. Relates to drum armature windings for electric generators, motors and converters, and more particularly to the manner of connecting such windings to the sections of the commutator. 1 claim.